KITSAP COUNTY DEPARTMENT OF PUBLIC WORKS
COUNTY ROAD PROJECT NO. 1632

NORTH KITSAP SERVICE CENTER

VOLUME 1 OF 3
CONTRACT PROVISIONS

KITSAP COUNTY DEPARTMENT OF PUBLIC WORKS
614 DIVISION STREET, MS-26
PORT ORCHARD, WASHINGTON 98366-4699
360.337.5777

APPROVED FOR CONSTRUCTION:

6/14/23
DATE — JOSEPH P. RUTAN, P.E., COUNTY ENGINEER

6/14/23
DATE — DAVID A. TUCKER, P.E., ASSISTANT DIRECTOR FOR UTILITIES

BACK OF COVER

Table of Contents

CALL FOR BIDS P-1
PROPOSAL P-5
BID BOND P-11
BIDDER RESPONSIBILITY STATEMENT P-13
CERTIFICATION OF COMPLIANCE WITH WAGE PAYMENT STATUTES P-23
NON-COLLUSION DECLARATION FORM P-25
SUBCONTRACTOR LIST P-27
PROPOSAL FOR INCORPORATING RECYCLED MATERIALS INTO THE PROJECT P-29
AGREEMENT A-1
PUBLIC WORKS PAYMENT BOND A-7
PUBLIC WORKS PERFORMANCE BOND A-9
SPECIAL PROVISIONS 1
INTRODUCTION TO THE SPECIAL PROVISIONS 5
DIVISION 1 GENERAL REQUIREMENTS 7
1-01 DEFINITIONS AND TERMS 7
1-01.1 General 7
1-01.2 Abbreviations 7
1-01.3 Definitions 11
1-01.4 Interpretations 16
1-02 BID PROCEDURES AND CONDITIONS 16
1-02.1 Qualifications of Bidder 16
1-02.2 Plans and Specifications 17
1-02.3 Estimated Quantities 17
1-02.4 Examination of Plans, Specifications, and Site of Work 17
1-02.5 Proposal Forms 20
1-02.6 Preparation of Proposal 20
1-02.7 Bid Deposit 22
1-02.8 Noncollusion Declaration and Lobbying Certification 23
1-02.9 Delivery of Proposal 24
1-02.10 Withdrawing, Revising, or Supplementing Proposal 24
1-02.11 Vacant 25
1-02.12 Public Opening of Proposals 25
1-02.13 Irregular Proposals 25
1-02.14 Disqualification of Bidders 25

1-02.15 Pre-Award Information 29
1-03 AWARD AND EXECUTION OF CONTRACT 29
1-03.1 Consideration of Bids 29
1-03.2 Award of Contract 30
1-03.3 Execution of Contract 30
1-03.4 Contract Bond 31
1-03.5 Failure to Execute Contract 32
1-03.6 Return of Bid Deposit 32
1-03.7 Judicial Review 32
1-04 SCOPE OF THE WORK 33
1-04.1 Intent of the Contract 33
1-04.2 Coordination of Contract Documents, Plans, Special Provisions, Specifications, and Addenda 33
1-04.3 Reference Information 34
1-04.4 Changes 34
1-04.5 Procedure, Protest, and Dispute by the Contractor 36
1-04.6 Variation in Estimated Quantities 37
1-04.7 Differing Site Conditions (Changed Conditions) 39
1-04.8 Progress Estimates and Payments 39
1-04.9 Use of Buildings or Structures 39
1-04.10 Use of Materials Found on the Project 39
1-05 CONTROL OF WORK 40
1-05.1 Authority of the Engineer 40
1-05.2 Authority of Assistants and Inspectors 42
1-05.3 Working Drawings 43
1-05.4 Conformity with and Deviations from Plans and Stakes 44
1-05.5 Tolerances 47
1-05.6 Inspection of Work and Materials 47
1-05.7 Removal of Defective and Unauthorized Work 48
1-05.8 Vacant 49
1-05.9 Equipment 49
1-05.10 Guarantees 50
1-05.11 Final Inspection and Commissioning 50
1-05.12 Final Acceptance 62
1-05.13 Superintendents, Labor, and Equipment of Contractor 63
1-05.14 Vacant 63

1-05.15 Method of Serving Notices 63
1-05.16 Water and Power 64
1-05.17 Project Management Communications 64
1-05.18 Record Drawings 67
1-06 CONTROL OF MATERIAL 69
1-06.0 Submittal Procedures 69
1-06.1 Approval of Materials Prior to Use 71
1-06.2 Acceptance of Materials 72
1-06.3 Manufacturer's Certificate of Compliance 73
1-06.4 Handling and Storing Materials 74
1-06.5 Owners Manuals and Operating Instructions 74
1-06.6 Recycled Materials 78
1-06.7 Substitutions 78
1-06.8 Mockups 80
1-06.9 Maintenance Materials 81
1-07 LEGAL RELATIONS AND RESPONSIBILITIES TO THE PUBLIC 81
1-07.1 Laws to be Observed 81
1-07.2 State Taxes 83
1-07.3 Fire Prevention and Merchantable Timber Requirements 85
1-07.4 Sanitation 86
1-07.5 Environmental Regulations 86
1-07.6 Permits and Licenses 89
1-07.7 Load Limits 89
1-07.8 High-Visibility Apparel 92
1-07.9 Wages 93
1-07.10 Worker's Benefits 96
1-07.11 Requirements for Nondiscrimination 97
1-07.13 Contractor's Responsibility for Work 103
1-07.14 Responsibility for Damage 104
1-07.15 Temporary Water Pollution Prevention 107
1-07.16 Protection and Restoration of Property 109
1-07.17 Utilities and Similar Facilities 112
1-07.18 Insurance 113
1-07.19 Gratuities 117
1-07.20 Patented Devices, Materials, and Processes 117
1-07.21 Rock Drilling Safety Requirements 117

1-07.22 Use of Explosives 117
1-07.23 Public Convenience and Safety 118
1-07.24 Rights of Way 120
1-07.25 Vacant 121
1-07.26 Personal Liability of Public Officers 121
1-07.27 No Waiver of State's Legal Rights 121
1-08 PROSECUTION AND PROGRESS 121
1-08.0 Preliminary Matters 121
1-08.1 Subcontracting 123
1-08.2 Assignment 128
1-08.3 Progress Schedule 128
1-08.4 Prosecution of Work 131
1-08.5 Time for Completion 136
1-08.6 Suspension of Work 138
1-08.7 Maintenance During Suspension 139
1-08.8 Extensions of Time 139
1-08.9 Liquidated Damages 141
1-08.10 Termination of Contract 142
1-09 MEASUREMENT AND PAYMENT 144
1-09.0 North Kitsap Service Center Bid Items 144
1-09.1 Measurement of Quantities 150
1-09.2 Weighing Equipment 152
1-09.3 Scope of Payment 157
1-09.4 Equitable Adjustment 158
1-09.5 Deleted or Terminated Work 158
1-09.6 Force Account 159
1-09.7 Mobilization 163
1-09.8 Payment for Material on Hand 166
1-09.9 Payments 167
1-09.10 Vacant 170
1-09.11 Disputes and Claims 170
1-09.12 Audits 173
1-09.13 Claims Resolution 175
1-10 TEMPORARY TRAFFIC CONTROL 177
1-10.1 General 177
1-10.2 Traffic Control Management 178

VOLUME 2 SPECIAL PROVISIONS
DIVISION 2 THROUGH 46

VOLUME 3 APPENDICES

THIS PAGE INTENTIONALLY LEFT BLANK

CALL FOR BIDS

KITSAP COUNTY DEPARTMENT OF PUBLIC WORKS
COUNTY ROAD PROJECT NO. 1632

NORTH KITSAP SERVICE CENTER

BID OPENING: DATE: **July 18, 2023** TIME: **11:00 AM**

Sealed bids for the project designated above will be received by Kitsap County Department of Public Works before the time and date indicated above, at which time they will be opened and publicly read aloud.

Bids will be received in person or by private carrier (UPS, Federal Express, etc.) at:

Kitsap County Department of Public Works
Third floor Reception Desk
507 Austin Avenue
Port Orchard, Washington

Bids delivered by US Postal Service shall be addressed to:

Kitsap County Department of Public Works
614 Division Street, MS-26
Port Orchard, Washington 98366-4699

Prospective bidders are hereby notified that they are solely responsible for ensuring timely delivery of their bid to the place of bid opening.

All bid proposals shall be accompanied by a bid proposal surety bond made payable to Kitsap County Department of Public Works in an amount equal to five percent (5%) of the amount of such bid proposal. Should the successful Bidder fail to enter into such contract and furnish satisfactory performance and payment bonds within the time stated in the Special Provisions, the bid proposal bond shall be forfeited to Kitsap County Department of Public Works.

Each proposal or bid shall be completely sealed in a separate envelope, properly addressed as stated above, with the name and address of the bidder and the name of the project plainly written on the outside of the envelope. A complete bid proposal shall include the following:

1) Proposal Form
2) Bid Bond

3) Bidder Responsibility Statement
4) Certification of Compliance with Wage Payment Statutes
5) Non-Collusion Affidavit
6) Subcontractor List
7) Proposal for Incorporating Recycled Materials into the Project

All of the above items must be complete in all respects, including signatures (notarized where required). Bidder shall acknowledge receipt of all addendums in the spaces provided. The successful Bidder will be required to submit a photocopy of their current Washington State Contractors Registration. Failure to include all items may be cause for the bid to be considered irregular and thereby rejected.

Bids or proposals received after the time set for the opening of bids will not be considered.

Bidders are notified that all bids are likely to be rejected if the lowest responsible bid received exceeds the Engineer's estimate by an unreasonable amount.

Kitsap County reserves the right to award the bid in a manner and on a basis, which will best serve the County, taking into consideration the Bidder Responsibility Statement included with the bids and the requirements of the Contract Provisions.

The award of the contract, if made, shall be made to the responsible Bidder submitting the lowest responsive bid, based upon the total sum of the extension of unit prices for the bid items.

DESCRIPTION OF WORK

This project will construct new facilities at 23026 Route 307/Bond Road NE, Poulsbo, WA 98370 on parcel number 062602-2-064-2007, a 15.64 acre site. Principal items of work include construction of:

- A Household Hazardous Waste Collection Facility building consisting of approximately 9,500 square feet tilt-up concrete structure with structural steel roofing and light gauge stud infill framing, and embedded hydronic heating, comprised of areas for sorting, bulking, storage, reuse, offices, restrooms, containment tank, and loading dock
- A Road Operations Facility building consisting of an approximately 17,900 square foot tilt-up concrete structure with structural steel roofing, light gauge stud infill framing, embedded hydronic heating, and photo-voltaic system, comprised of offices, storage, locker and washroom areas, and vehicle and equipment maintenance shop area
- Generator

- Covered parking
- Covered and uncovered storage areas for equipment and bulk materials
- Vehicle wash system and wash bay structure
- Fueling station
- EV charging stations
- Sander insert rack
- Other site improvements including clearing and grubbing, grading, HMA and concrete surfacing, sidewalk, curb and gutter, storm sewer system including vaults and ponds, utilities, illumination and other site electrical systems, onsite sewage system, landscaping, irrigation, striping, signing, security gates, and fencing and miscellaneous items

The engineer's estimate ranges from $27,000,000 to $30,000,000.

OBTAINING PLANS AND CONTRACT PROVISIONS:
Electronic copies of the Plans and Contract Provisions in PDF format are available on the internet through Kitsap County's website, Department of Public Works, Road Projects Open for Bid, located at http://kcowa.us/roadbid.

Paper copies of the Contract Plans and Provisions for the proposed work may be obtained from the Kitsap County Department of Public Works at 507 Austin Avenue, 3rd floor Reception Desk, Port Orchard, Washington for a non-refundable fee of $600.00 for each set plus $15.00 to cover postage and handling if mailing is requested. To order these Contract Documents or to obtain a Bid Proposal Package at no cost, please call 360-337-5777 or email at kitsap1@kitsap.org. Plans and Contract Provisions will not be shipped until the fee is received.

To be added to the Plan Holder List, please complete the form available online at https://www.kitsapgov.com/pw/Pages/planholders.aspx. Any questions or issues, please call 360-337-5777 or email at kitsap1@kitsap.gov.

CONTACT PERSON
Any prospective Bidder having questions or desire an explanation or interpretation of the Bid Documents are requested to contact Jacques Dean, Road Superintendent at (360) 337-4671, or Jdean@kitsap.gov by close of business 5 business days preceding the bid opening.

KITSAP COUNTY BOARD OF COMMISSIONERS

THIS PAGE INTENTIONALLY LEFT BLANK

PROPOSAL
KITSAP COUNTY DEPARTMENT OF PUBLIC WORKS
COUNTY ROAD PROJECT NO. 1632

NORTH KITSAP SERVICE CENTER

To the Honorable Board of Commissioners
Kitsap County
614 Division Street
Port Orchard, Washington 98366

1. Pursuant to and in compliance with your Advertisement for Bids and the other documents relating thereto, the undersigned Bidder, having familiarized themselves with the terms of the project related to those items herein bid, being aware of the local conditions affecting the performance of a Contract covering the items bid, having knowledge of the cost of the work at the place where the work is to be done, having familiarized themselves with the Contract Documents, hereby proposes and agrees to perform the work and/or to furnish the equipment, and to furnish any and all of the labor, materials, tools, expendable equipment and all utility and transportation services necessary to perform a Contract covering any or all of those items herein bid and to complete in a workmanlike manner all work covered by said Contract in connection with the Owner's Improvement Project, for an amount computed upon the basis of the quantity of work actually performed at the following bid prices:

NOTE: UNIT PRICES FOR ALL ITEMS, ALL EXTENSIONS, AND THE TOTAL AMOUNT OF BID MUST BE SHOWN. All prices shall be in legible figures (not words) written in ink or typed. The proposal shall include: A unit price for each item (omitting digits more than four places to the right of the decimal point); an extension for each unit price (omitting digits more than two places to the right of the decimal point); the total Contract price (the sum of all extensions).

BASE BID

Item No.	Description	Quantity	Unit	Unit Price	Amount
1	Temporary Erosion/Water Pollution Control	1	LS		
2	Surveying	1	LS		
3	Type B Schedule (Minimum Bid Amount $30,000)	1	LS		
4	Mobilization	1	LS		
5	Operation and Maintenance Manuals	1	LS		
6	Excavation Support Systems	1	LS		
7	Excavation Including Haul	37,000	CY		
8	Embankment Compaction	39,700	CY		
9	Special Borrow Including Haul	1,000	TN		
10	Crushed Surfacing Base Course	13,300	TN		
11	HMA Cl. ½ In PG 64-22	7,000	TN		
12	Site Improvements	1	LS		
13	Road Operations Facility Building	1	LS		
14	Household Hazardous Waste Collection Facility Building	1	LS		
15	Final Cleaning (Minimum Bid Amount $20,000)	1	LS		
16	Minor Change	1	EST	$ 1.00	$ 80,000.00
17	Record Drawings (Minimum Bid Amount $30,000)	1	LS		

BASE BID SUBTOTAL $_____

SALES TAX @ 9.2% $_____

BASE BID TOTAL $_____

ADDITIVE ALTERNATE 1

Item No.	Description	Quantity	Unit	Unit Price	Amount
19	Photo-voltaic System – Added Capacity	1	LS		

ADDITIVE ALTERNATE 1 SUBTOTAL $_____

SALES TAX @ 9.2% $_____

ADDITIVE ALTERNATE 1 TOTAL $_____

GRAND TOTAL (Base Bid + Additive Alternate 1, incl sales tax) $_____

2. Bidder shall NOT include sales tax in the lump sum and unit price bid items in accordance with Section 1-07.2(2) of the Special Provisions.

3. The undersigned Bidder hereby proposes and agrees to commence work under this Contract, if awarded to them, in accordance with Sections 1-08.4 and 1-08.5 of the Special Provisions. They further agree to complete the contract within **400 working days**.

4. The agreed liquidated damage to the Owner shall be in accordance with Liquidated Damages as described in Section 1-08.9 of the Special Provisions.

5. The Owner reserves the right to delete all or any portions of the work as outlined in the Contract Documents.

6. The required bid security in the amount of five percent (5%) of the total bid is hereto attached.

7. It is understood that the Contractor is responsible for obtaining and completing all required government forms.

8. Receipt of the following Addenda to the Contract Document is hereby acknowledged.

ADDENDUM #	DATE OF RECEIPT OF ADDENDUM	SIGNED ACKNOWLEDGMENT
1		
2		
3		
4		
5		
6		

(Note: Failure to acknowledge receipt of the Addenda may be considered an irregularity in the proposal).

9. Notice of Acceptance of this bid or requests for additional information should be addressed to the undersigned at the address stated below and unless otherwise notified in writing, this address shall be used by the successful bidder during the life of the Contract for all official notices.

10. By signing this Proposal, the Bidder certifies that they have read and understand all of the terms and Conditions of the Contract Plans, these Special Provisions, and agrees to comply with them.

Date: _____

Proper Name of Bidder (Type or Print): _____

By (Signature): _____

Name and Title (Type or Print Name and Title of Signatory): _____

Street Address: _____

City, State and Zip Code: _____

Telephone Number with Area Code: _____

Fax Number with Area Code: _____

Mailing Address, if different from above: _____

_____

E-mail Address (to be used by the County to send award documents) _____

THIS PAGE INTENTIONALLY LEFT BLANK

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, as Principal, and _____as Surety, are hereby held and firmly bound unto Kitsap County Department of Public Works as Owner in the penal sum of _____for payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, successors and assigns. Signed this _____ day of _____ , 2023.
The Condition of the above obligation is such that whereas the Principal has submitted

To Kitsap County Department of Public Works, a certain BID, attached hereto and made

a part hereof to enter a contract in writing, for the _____
_____
_____

NOW, THEREFORE,

(a) If said BID be rejected, or

(b) If said Bid shall be accepted and the Principal shall execute and deliver a contract in the Form of Contract attachment hereto (properly completed in accordance with said BID) and shall furnish a BOND for faithful performance of said contract, and for the payment of all persons performing labor and furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said BID, then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its BOND shall be in no way impaired or affected by any extension of the time within which the OWNER may accept such BID; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are Corporations have set their Corporation seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

_____
Principal

_____
Surety

By:_____

THIS PAGE INTENTIONALLY LEFT BLANK

BIDDER RESPONSIBILITY STATEMENT

Each Bidder shall prepare and submit the following information with their bid.

By signing the signature page of the Proposal, the Bidder affirms that the following information is true and correct.

Name of Bidder: _____

Business Address: _____

A) MANDATORY BIDDER RESPONSIBILITY CRITERIA (RCW 39.04.350)

1. Washington State Contractors License Number: _____

   Effective Date: _____

2. State of Washington Unified Business Identifier (UBI) No.: _____

   _____

3. Do you have industrial insurance (workers' compensation) coverage for your employees working in Washington as required by Title 51 RCW?

   Yes: ☐ No: ☐ Not Applicable: ☐

4. Washington State Employment Security Department number as required by Title 51 RCW.

   Number: _____ Not Applicable: ☐

5. Washington State Department of Revenue state excise tax registration number as required by Title 82 RCW.

   Number: _____ Not Applicable: ☐

6. Have you ever been disqualified from bidding on any public works contract under RCW 39.06.010 or 39.12.065(3)?

   Yes: ☐ No: ☐

7. Have you received training on the requirements related to public works and prevailing wage?

   Yes: ☐ No: ☐ Exempt: ☐

B) SUPPLEMENTAL BIDDER RESPONSIBILITY CRITERIA (SPECIAL PROVISIONS SECTION 1-02.14)

1. Do you own delinquent taxes to the State of Washington Department of Revenue?

   Yes: ☐ No: ☐

2. Are you currently debarred or suspended from bidding by the Federal government?

   Yes: ☐ No: ☐

3. Does your standard subcontract form include the subcontract responsibility language required by RCW 39.06.020?

   Yes: ☐ No: ☐

4. Do you have any established procedure which your company utilizes to validate the responsibility of each of your subcontractors and any sub-tier contractors?

   Yes: ☐ No: ☐

5. Do you have any record of prevailing wage violations in the last 5 years as determined by the Washington State Department of Labor and Industries?

   Yes: ☐ No: ☐

6. Have you had any claims against retainage or payment bonds for public works projects in the last 3 years?

   Yes: ☐ No: ☐

7. Has your company or its owners been convicted of a crime involving bidding on a public works contract in the last 5 years?

   Yes: ☐ No: ☐

8. Has your company had any public works contract terminated for cause or terminated for default by a government agency in the last 5 years?

   Yes: ☐ No: ☐

9. Has your company had any lawsuits with judgments entered against the company in the last 5 years?

   Yes: ☐ No: ☐

C) CONTRACTING AGENCY SPECIFIC BIDDER RESPONSIBILITY CRITERIA (SPECIAL PROVISIONS SECTION 1-02.14)

1. Gross amount of contracts currently in hand: _____

2. Provide a list of more important construction projects completed by your company in the last 5 years. Include project name, year, approximate cost, name and current phone number of project engineer or owner:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

3. Bank references: _____

_____

4. Bonding company: _____

_____

Supporting documentation verifying that the bidder meets the supplemental and Contracting Agency specific responsibility criteria stated in Sections B and C above may be requested by the Contracting Agency in accordance with Section 1-02.14 of the Special Provisions.

THIS PAGE INTENTIONALLY LEFT BLANK

STATEMENT OF QUALIFICATIONS FOR CONTRACTOR PERSONNEL

This form shall be completed in its entirety and submitted with the bid, as stated in Special Provisions Section 1-02.14.

The Kitsap County Public Works Department will be the sole judge in determining if the prospective contractor meets the minimum experience requirements.

Prime Contractor Project Manager:

Name: _____
Address: _____
Phone: _____
Years of PM Experience: _____

List three (3) successfully completed projects that were similar in scope, time and complexity within the last (10) years. Written Project Descriptions shall be submitted along with the bid proposal.

#1 Project Name: _____
Owner: _____
Contact Person: _____ Contact Phone: _____
Name of Contractor Employed By: _____
Completion Date: _____

#2 Project Name: _____
Owner: _____
Contact Person: _____ Contact Phone: _____
Name of Contractor Employed By: _____
Completion Date: _____

#3 Project Name: _____
Owner: _____
Contact Person: _____ Contact Phone: _____
Name of Contractor Employed By: _____
Completion Date: _____

Prime Contractor Superintendent:

Name: _____

Address: _____

Phone: _____

Years of Superintendent Experience: _____

List three (3) successfully completed projects that were similar in scope, time and complexity within the last (10) years. Written Project Descriptions shall be submitted along with the bid proposal.

#1 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

#2 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

#3 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

Electrical Contractor:

The Electrical Contractor and the Electrical Contractor's Field/Project Supervisor assigned to this project shall each have a minimum of 3 successfully completed projects that were similar in scope of work within the last (10) years.

Contractor Name: _____

Address: _____

Phone: _____

Years of Experience: _____

List three (3) successfully completed projects similar in scope of work within the last (10) years. Written Project Descriptions shall be submitted along with the bid proposal.

#1 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

#2 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

#3 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

Mechanical Contractor:

The Mechanical Contractor and the Mechanical Contractor's Field/Project Supervisor assigned to this project shall each have a minimum of 3 successfully completed projects that were similar in scope of work within the last (10) years.

Contractor Name: _____

Address: _____

Phone: _____

Years of Experience: _____

List three (3) successfully completed projects similar in scope of work within the last (10) years. Written Project Descriptions shall be submitted along with the bid proposal.

#1 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

#2 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

#3 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

Earthwork Contractor:

The Earthwork Contractor and the Earthwork Contractor's Field/Project Supervisor assigned to this project shall each have a minimum of 3 successfully completed projects that were similar in scope of work within the last (10) years.

Contractor Name: _____

Address: _____

Phone: _____

Years of Experience: _____

List three (3) successfully completed projects similar in scope of work within the last (10) years. Written Project Descriptions shall be submitted along with the bid proposal.

#1 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

#2 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

#3 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

Solider Pile Wall Contractor:

The Solider Pile Wall Contractor and the Solider Pile Wall Contractor's Field/Project Supervisor assigned to this project shall each have a minimum of 3 successfully completed projects that were similar in scope of work within the last (10) years.

Contractor Name: _____

Address: _____

Phone: _____

Years of Experience: _____

List three (3) successfully completed projects similar in scope of work within the last (10) years. Written Project Descriptions shall be submitted along with the bid proposal.

#1 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

#2 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

#3 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

Structural Concrete Contractor:

The Structural Concrete Contractor and the Structural Concrete Contractor's Field/Project Supervisor assigned to this project shall each have a minimum of 3 successfully completed projects that were similar in scope of work within the last (10) years.

Contractor Name: _____

Address: _____

Phone: _____

Years of Experience: _____

List three (3) successfully completed projects similar in scope of work within the last (10) years. Written Project Descriptions shall be submitted along with the bid proposal.

#1 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

#2 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

#3 Project Name: _____

Owner: _____

Contact Person: _____ Contact Phone: _____

Name of Contractor Employed By: _____

Completion Date: _____

This form must be submitted with the Bid Proposal or as a Supplement to the Bid no later than 24 hours after the time for delivery of the Bid Proposal, as provided for in Section 1-02.9 of the Contract Provisions.

CERTIFICATION OF COMPLIANCE WITH WAGE PAYMENT STATUTES

The bidder hereby certifies that, within the three-year period immediately preceding the bid solicitation date **June 20, 2023**, the bidder is not a "willful" violator, as defined in RCW 49.48.082, of any provision of chapters 49.46, 49.48, or 49.52 RCW, as determined by a final and binding citation and notice of assessment issued by the Department of Labor and Industries or through a civil judgment entered by a court of limited or general jurisdiction.

I certify under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct.

_____
Bidder's Business Name

_____
Signature of Authorized Official*

_____
Printed Name

_____
Title

_____ _____ _____
Date City State

Check One:

Sole Proprietorship ☐ Partnership ☐ Joint Venture ☐ Corporation ☐

State of Incorporation, or if not a corporation, State where business entity was formed:

_____

If a co-partnership, give firm name under which business is transacted:

_____

** If a corporation, proposal must be executed in the corporate name by the president or vice-president (or any other corporate officer accompanied by evidence of authority to sign). If a co-partnership, proposal must be executed by a partner.*

THIS PAGE INTENTIONALLY LEFT BLANK

Failure to return this Declaration as part of the bid proposal package will make the bid nonresponsive and ineligible for award.

NON-COLLUSION DECLARATION FORM

I, by signing the proposal, hereby declare, under penalty of perjury under the laws of the United States that the following statements are true and correct:

1. That the undersigned person(s), firm, association or corporation has (have) not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with the project for which this proposal is submitted.
2. **That by signing the signature page of this proposal, I am deemed to have signed and to have agreed to the provisions of this declaration.**

NOTICE TO ALL BIDDERS

To report rigging activities call:

1-800-424-9071

The U.S. Department of Transportation (USDOT) operates the above toll-free "hotline" Monday through Friday, 8:00 a.m. to 5:00 p.m., eastern time. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the "hotline" to report such activities.

The "hotline" is part of USDOT's continuing effort to identify and investigate highway construction contract fraud and abuse and is operated under the direction of the USDOT Inspector General. All information will be treated confidentially and caller anonymity will be respected.

DOT Form 272-036I EF
07/2011

THIS PAGE INTENTIONALLY LEFT BLANK

SUBCONTRACTOR LIST

Local Agency Name
Local Agency Address

Local Agency Subcontractor List

Prepared in compliance with RCW 39.30.060 as amended

To Be Submitted with the Bid Proposal

Project Name _____

Failure to list subcontractors with whom the bidder, if awarded the contract, will directly subcontract for performance of the work of structural steel installation, rebar installation, heating, ventilation and air conditioning, plumbing, as described in Chapter 18.106 RCW, and electrical, as described in Chapter 19.28 RCW or naming more than one subcontractor to perform the same work will result in your bid being non-responsive and therefore void.

Subcontractor(s) with whom the bidder will directly subcontract that are proposed to perform the work of structural steel installation, rebar installation, heating, ventilation and air conditioning, plumbing, as described in Chapter 18.106 RCW, and electrical as described in Chapter 19.28 RCW must be listed below. The work to be performed is to be listed below the subcontractor(s) name.

To the extent the Project includes one or more categories of work referenced in RCW 39.30.060, and no subcontractor is listed below to perform such work, the bidder certifies that the work will either (I) be performed by the bidder itself, or (II) be performed by a lower tier subcontractor who will not contract directly with the bidder.

Subcontractor Name _____

Work to be performed _____

Subcontractor Name _____

Work to be performed _____

Subcontractor Name _____

Work to be performed _____

Subcontractor Name _____

Work to be performed _____

Subcontractor Name _____

Work to be performed _____

* Bidder's are notified that it is the opinion of the enforcement agency that PVC or metal conduit, junction boxes, etc, are considered electrical equipment and therefore considered part of electrical work, even if the installation is for future use and no wiring or electrical current is connected during the project.

DOT Form 271-015A
Revised 06/2020

THIS PAGE INTENTIONALLY LEFT BLANK

PROPOSAL FOR INCORPORATING RECYCLED MATERIALS INTO THE PROJECT

Proposal for Incorporating Recycled Materials into the Project

In compliance with RCW 70A.205.700, the Bidder shall propose below, the total percent of construction aggregate and concrete materials to be incorporated into the Project that are recycled materials. Calculated percentages must be within the amounts allowed in Section 9-03.21(1)E, Table on Maximum Allowable Percent (By Weight) of Recycled Material, of the Standard Specifications.

Proposed total percentage: _____ percent.

Note: *Use of recycled materials is highly encouraged within the limits shown above, but does not constitute a Bidder Preference, and will not affect the determination of award, unless two or more lowest responsive Bid totals are exactly equal, in which case proposed recycling percentages will be used as a tie-breaker, per section 1-03.1 of the Special Provisions. Regardless, the Bidder's stated proposed percentages will become a goal the Contractor should do its best to accomplish.*

Bidder: _____

Signature of Authorized Official: _____

Date: _____

THIS PAGE INTENTIONALLY LEFT BLANK

AGREEMENT

This Agreement, made and entered into this _____ day of _____, 2023 by and between Kitsap County, through the BOARD OF COUNTY COMMISSIONERS of Kitsap County, State of Washington, hereinafter referred to as the "COUNTY", and, _____, a general Contractor licensed by the State of Washington, for themselves, their heirs, executors, administrators, successors, and assigns, hereinafter referred to as the "CONTRACTOR", collectively referred to as the Parties.

RECITALS:
WHEREAS, the COUNTY desires to construct the North Kitsap Service Center, in Commissioner District #1

WHEREAS, the CONTRACTOR has been selected by competitive bid as the "responsible bidder with the lowest responsive bid," as defined under RCW 39.04.010;

NOW THEREFORE, in consideration of the mutual benefits and covenants contained herein, the COUNTY and the CONTRACTOR mutually agree as follows:

CONTRACT DOCUMENTS:
This Agreement hereby incorporates the recitals and the Contract Documents, which documents are incorporated herein by reference. The Contract Documents include, but are not limited to, the Contract Provisions for "**North Kitsap Service Center**," Call for Bids, Contractors accepted Bid Proposal, the Specifications and Special Provisions, Contract Plans and Drawings, Addenda, applicable Bonds, and the 2023 WSDOT/APWA Standard Specifications for Road, Bridge, and Municipal Construction, hereinafter referred to as the "Standard Specifications".

1) DESCRIPTION OF THE WORK:
The CONTRACTOR agrees to perform the Work as generally described as follows and more fully described by the Contract Documents (the "Project"):
The Project is the construction of a new Household Hazardous Waste Collection and Road Operations Facilities on a 15.64 acre site located at 23026 Route 307/Bond Road NE, Poulsbo, WA 98370, Tax Parcel Number 062602-2-064-2007.
Principal items of Work include construction of:

- A Household Hazardous Waste Collection Facility building consisting of approximately 9,500 square feet tilt-up concrete structure with structural steel roofing and light gauge stud infill framing, and embedded hydronic heating, comprised of areas for sorting, bulking, storage, reuse, offices, restrooms, containment tank, and loading dock
- A Road Operations Facility building consisting of an approximately 17,900 square foot tilt-up concrete structure with structural steel roofing, light gauge stud infill framing, embedded hydronic heating, and photo-voltaic system, comprised of offices, storage, locker and washroom areas, and vehicle and equipment maintenance shop area

- Generator
- Covered parking
- Covered and uncovered storage areas for equipment and bulk materials
- Vehicle wash system and wash bay structure
- Fueling station
- EV charging stations
- Sander insert rack
- Other site improvements including clearing and grubbing, grading, HMA and concrete surfacing, sidewalk, curb and gutter, storm sewer system including vaults and ponds, utilities, illumination and other site electrical systems, onsite sewage system, landscaping, irrigation, striping, signing, security gates, and fencing and miscellaneous items

The CONTRACTOR shall furnish all the materials, supplies, tools, equipment, labor, and other services necessary for the construction and completion of the Work described herein, in accordance with this Agreement, including the Contract Documents.

2) BINDING EFFECT:
The covenants and conditions contained in this Agreement shall apply to and bind the Parties, heirs, legal representatives, successors and assigns of the Parties.

3) TIME IS OF THE ESSENCE:
The CONTRACTOR agrees to work promptly and to fully complete the Work within the required time limits as described in this Agreement and the Contract Documents. **Failure to complete within the allowed time limit will subject the CONTRACTOR to Liquidated Damages, as described in Section 1-08.9, Liquidated Damages, of the Contract Documents.**

4) TIME FOR COMPLETION:
The work to be performed under this Agreement shall commence and complete in accordance with Sections 1-08.4, Notice to Proceed and Prosecution of Work, and 1-08.5, Time for Completion, of the Contract Documents and Physically Completion of the Work shall be achieved within **400 WORKING DAYS**, unless Contract Time is extended in accordance with the provisions of this Agreement and the Contract Documents.

5) COMPENSATION:
The COUNTY agrees to pay the CONTRACTOR for the Work described and completed according to this Agreement and the Contract Documents the sum of [spell out the amount in words and in numbers] ,$ _____. This sum shall include state sales tax.

6) INDEPENDENT CONTRACTOR:
The CONTRACTOR shall perform the Work under this Agreement as an independent CONTRACTOR and not as an agent, employee or servant of the COUNTY. The Parties agree that the CONTRACTOR is not entitled to any benefits or rights enjoyed by

employees of the COUNTY. CONTRACTOR shall comply with all laws regarding workers' compensation.

7) DISCRIMINATION AND AMERICANS WITH DISABILITIES ACT (ADA):
The CONTRACTOR agrees to comply with all provisions of the Americans with Disabilities Act and all regulations interpreting or enforcing said Act. The CONTRACTOR agrees to comply with all Federal, State and County laws and regulations in effect pertaining to non-discrimination. Violation of this section may be treated as a breach of this Agreement.

8) LIABILITY FOR NEGLIGENCE:
The CONTRACTOR shall be liable for any additional expenses incurred by the COUNTY as a result of carelessness or negligence on the part of the CONTRACTOR, the CONTRACTOR's agents, or the CONTRACTOR's employees. The CONTRACTOR agrees that the COUNTY may deduct such additional costs on its own behalf from monies due, or to become due, to the CONTRACTOR.

9) TERMINATION:
This Agreement may be terminated by the officials or agents of the COUNTY authorized to contract for or supervise the execution of the Work in accordance with Section 1-08.10 of the Standard Specifications.

10) MODIFICATION
There shall be no modification of this Agreement, except in writing, executed by the Parties with the same formalities as this Agreement. Change Orders totaling less than 10% of the total contract amount may be executed by the Director of Public Works or their authorized agent. Change Orders that exceed 10% of the total contract amount shall be valid provided they are executed by the Chair of the Board of County Commissioners or their authorized agent.

11) HOLD HARMLESS:
The CONTRACTOR shall indemnify and hold harmless the COUNTY and its officers, officials, agents and employees from, and shall process and defend at its expense, all claims, injuries, losses, demands or suits at law or equity arising in whole or in part from the CONTRACTOR's performance of any of its obligations under this Agreement; provided that nothing herein shall require the CONTRACTOR to indemnify the COUNTY against and hold harmless the COUNTY from claims, injuries, losses, demands, or suits based upon the sole negligence of the COUNTY, its agents, officers, and employees; and provided further that if claims, injuries, losses, demands or suits are caused by or result from the concurrent negligence of (a) the CONTACTOR or CONTRACTOR's agents or employees, and (b) the COUNTY or COUNTY's agents, officers, officials or employees, this indemnity provision shall be valid and enforceable only to the extent of the CONTRACTOR's negligence or the negligence of the CONTRACTOR's agents or employees.

The CONTRACTOR expressly assumes potential liability for actions brought by the CONTRACTOR's own employees against the COUNTY; and, solely for the purpose of this indemnification and defense, the CONTRACTOR specifically waives any immunity under

the state industrial insurance law, Title 51 RCW. The CONTRACTOR recognizes that this waiver was specifically entered into pursuant to the provisions of RCW 4.24.115 and was subject of mutual negotiation. This subsection shall survive expiration or termination of this Agreement.

12) INSURANCE REQUIREMENTS:
Section 1-07.18 of the Contract Documents shall govern this Agreement.

13) VENUE AND CHOICE OF LAW:
Any action at law, suit in equity, or other judicial proceeding for the enforcement of this contract or any provisions thereof shall be instituted as provided for in RCW 36.01.050. It is mutually understood and agreed that this Agreement shall be governed by the laws of the State of Washington, both as to interpretation and performance.

14) INTEGRATION CLAUSE:
This instrument embodies the entire agreement of the Parties. There are no promises, terms, conditions or obligations other than those contained herein; and this Agreement shall supersede all previous communications, representations or agreements, either verbal or written, between Parties.

15) AUTHORIZATION:
Each party signing below warrants to the other party, that they have the full power and authority to execute this Agreement on behalf of the party for whom they sign.

16) COMPLIANCE WITH LAWS:
The CONTRACTOR shall comply with all applicable federal, state and local laws, rules and regulations, as amended, in performing this Agreement.

17) SEVERABILITY:
a. If a court of competent jurisdiction holds any part, term or provision of this Agreement to be illegal, or invalid in whole or in part, the validity of the remaining provisions shall not be affected, and the Parties rights and obligations shall be construed and enforced as if this Agreement did not contain the particular provision held to be invalid.

b. If it should appear that any provision of this Agreement is in conflict with any statutory provision of the United States or State of Washington, said provision which may conflict therewith shall be deemed inoperative and null and void insofar as it may be in conflict therewith, and shall be deemed modified to conform to such statutory provision.

18) CONFLICTS PROVISION:
In the event language in this Agreement conflicts with the requirements in the Standard Specifications, the language in this Agreement and the Contract Documents controls.

19) RIGHTS and REMEDIES:
No action or failure to act by the COUNTY shall constitute a waiver of a right or duty afforded the COUNTY under this Agreement the Contract Documents, nor shall such

action or failure to act constitute approval of an acquiescence in a breach therein, except as may be specifically agreed in writing.

20) THIRD-PARTY AGREEMENTS:
Neither this Agreement nor the Contract Documents shall not be construed to create a contractual relationship of any kind between the COUNTY and any Subcontractor or any persons other than the COUNTY and the CONTRACTOR.

21) RECORDS RETENTION:
The wage, payroll, bid and cost records of the CONTRACTOR and its Subcontractors, and all records subject to audit in accordance with the Contract Documents shall be retained for a period of not less than six (6) years after the date of Final Acceptance of the Contract Documents.

22)COMPLIANCE WITH PUBLIC RECORDS ACT

CONTRACTOR acknowledges that the County is subject to the Public Records Act, chapter 42.56 RCW ("PRA"). All records owned, used, or retained by the County are public records subject to disclosure unless exempt under the Act, whether or not such records are in the possession or control of the County or CONTRACTOR. CONTRACTOR shall cooperate with the County so the County may comply with all of its obligations under the PRA. Contractor shall promptly provide the County with all records relating to this Agreement requested by the County for purposes of complying with the PRA. In addition to its other indemnification and defense obligations under this Agreement, CONTRACTOR shall indemnify and defend the County from and against any and all losses, penalties, fines, claims, demands, expenses (including, but not limited to, attorney's fees and litigation expenses), suits, judgments, or damage arising from or relating to any failure of CONTRACTOR to comply with this subsection. This subsection shall survive expiration or termination of this Agreement.

23)CONTRACT BOND:
Payment and performance bonds for this project have been issued by_____
_____, Surety Company of_____
Street address:_____City:_____
_____
Telephone:_____Contact Person:_____
_____
in the amount of_____

IN WITNESS WHEREOF, the said CONTRACTOR has executed this instrument, and the said Board of County Commissioners of aforesaid COUNTY pursuant to resolution duly adopted has caused this instrument to be executed by and in the name of said Board by its Chair, duly attested by its Clerk, the day and year first above written, and the seal of said Board to be hereunto affixed on the date this instrument first above written.

CONTRACTOR

_____

BY _____

TITLE _____

BOARD OF COUNTY COMMISSIONERS
KITSAP COUNTY, WASHINGTON

_____

CHARLOTTE GARRIDO, Chair

_____

KATHERINE T. WALTERS, Commissioner

_____

CHRISTINE ROLFES, Commissioner

Foregoing contract approved and ratified:

_____

ATTEST

_____

Dana Daniels, Clerk of the Board

PUBLIC WORKS PAYMENT BOND

to _____, WA

Bond No. _____

_____, Washington, (_____) has awarded to _____ (Principal), a Contract for the construction of the project designated as _____, Project No. _____, in _____, Washington (Contract), and said Principal is required under the terms of that Contract to furnish a payment bond in accord with Title 39.08 Revised Code of Washington (RCW) and (where applicable) 60.28 RCW.

The Principal and _____ (Surety), a corporation organized under the laws of the State of _____ and licensed to do business in the State of Washington as surety and named in the current list of "Surety Companies Acceptable in Federal Bonds" as published in the Federal Register by the Audit Staff Bureau of Accounts, U.S. Treasury Dept., are jointly and severally held and firmly bound to _____, in the sum of _____ US Dollars ($_____) Total Contract Amount, subject to the provisions herein.

This statutory payment bond shall become null and void, if and when the Principal, its heirs, executors, administrators, successors, or assigns shall pay all persons in accordance with RCW Titles 60.28, 39.08, and 39.12 including all workers, laborers, mechanics, subcontractors, lower tier subcontractors, and material suppliers, and all persons who shall supply such contractor or subcontractor with provisions and supplies for the carrying on of such work, and all taxes incurred on said Contract under Title 50 and 51 RCW and all taxes imposed on the Principal under Title 82 RCW; and if such payment obligations have not been fulfilled, this bond shall remain in full force and effect.

The Surety agrees to indemnify, defend, and protect the _____ against any claim of direct or indirect loss resulting from the failure of the Principal, its heirs, executors, administrators, successors, or assigns, (or the subcontractors or lower tier subcontractors of the Principal) to pay all laborers, mechanics, subcontractors, lower tier subcontractors materialpersons, and all persons who shall supply such contractor or subcontractors with provisions and supplies for the carrying on of such work.

The Surety for value received agrees that no change, extension of time, alteration or addition to the terms of the Contract, the specifications accompanying the Contract, or to the work to be performed under the Contract shall in any way affect its obligation on this bond, except as provided herein, and waives notice of any change, extension of time, alteration or addition to the terms of the Contract or the work performed. The Surety agrees that modifications and changes to the terms and conditions of the Contract that increase the total amount to be paid the Principal shall automatically increase the obligation of the Surety on this bond and notice to Surety is not required for such increased obligation.

This bond may be executed in two (2) original counterparts, and shall be signed by the parties' duly authorized officers. This bond will only be accepted if it is accompanied by a fully executed and original power of attorney for the officer executing on behalf of the surety.

The Surety agrees to be bound by the laws of the state of Washington and subjected to the jurisdiction of the state of Washington.

PRINCIPAL		SURETY	
_____		_____	
Principal Signature	Date	Surety Signature	Date
_____		_____	
Printed Name		Printed Name	
_____		_____	
Title		Title	

Local office/agent of Surety Company:

Name _____ Telephone _____

Address _____

DOT Form 272-003A EF
12/2019

THIS PAGE INTENTIONALLY LEFT BLANK

PUBLIC WORKS PERFORMANCE BOND

to _____, WA

Bond No. _____

_____, Washington, (_____) has awarded to _____ (Principal), a Contract for the construction of the project designated as _____, Project No. _____, in _____, Washington (Contract), and said Principal is required under the terms of that Contract to furnish a bond for performance of all obligations under the Contract.

The Principal, and _____ (Surety), a corporation organized under the laws of the State of _____ and licensed to do business in the State of Washington as surety and named in the current list of "Surety Companies Acceptable in Federal Bonds" as published in the Federal Register by the Audit Staff Bureau of Accounts, U.S. Treasury Dept., are jointly and severally held and firmly bound to the _____, in the sum of _____ US Dollars ($_____) Total Contract Amount, subject to the provisions herein.

This statutory performance bond shall become null and void, if and when the Principal, its heirs, executors, administrators, successors, or assigns shall well and faithfully perform all of the Principal's obligations under the Contract and fulfill all the terms and conditions of all duly authorized modifications, additions, and changes to said Contract that may hereafter be made, at the time and in the manner therein specified; and if such performance obligations have not been fulfilled, this bond shall remain in full force and effect.

The Surety agrees to indemnify, defend, and protect the _____ against any claim of direct or indirect loss resulting from the failure of the Principal, its heirs, executors, administrators, successors, or assigns (or any of the employees, subcontractors, or lower tier subcontractors of the Principal) to faithfully perform the Contract.

The Surety for value received agrees that no change, extension of time, alteration or addition to the terms of the Contract, the specifications accompanying the Contract, or to the work to be performed under the Contract shall in any way affect its obligation on this bond, and waives notice of any change, extension of time, alteration or addition to the terms of the Contract or the work performed. The Surety agrees that modifications and changes to the terms and conditions of the Contract that increase the total amount to be paid the Principal shall automatically increase the obligation of the Surety on this bond and notice to Surety is not required for such increased obligation.

This bond may be executed in two (2) original counterparts, and shall be signed by the parties' duly authorized officers. This bond will only be accepted if it is accompanied by a fully executed and original power of attorney for the officer executing on behalf of the surety.

The Surety agrees to be bound by the laws of the state of Washington and subjected to the jurisdiction of the state of Washington.

PRINCIPAL		SURETY	
_____		_____	
Principal Signature	Date	Surety Signature	Date
_____		_____	
Printed Name		Printed Name	
_____		_____	
Title		Title	

Local office/agent of Surety Company:

Name _____ Telephone _____

Address _____

DOT Form 272-002A
12/2019

THIS PAGE INTENTIONALLY LEFT BLANK

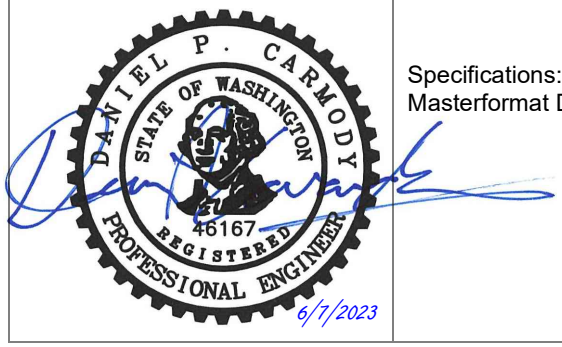
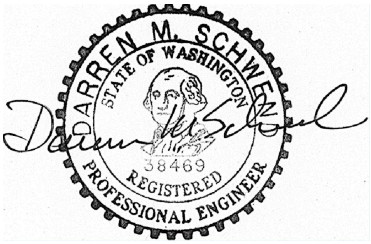
SPECIAL PROVISIONS

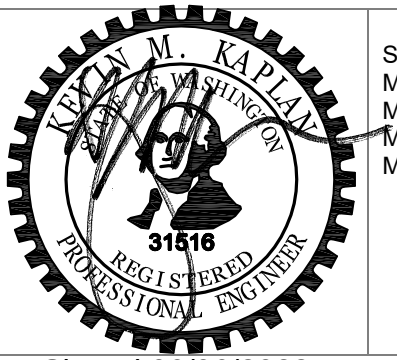
KITSAP COUNTY DEPARTMENT OF PUBLIC WORKS
COUNTY ROAD PROJECT NO. 1632

NORTH KITSAP SERVICE CENTER

The Professional Engineer's seal and signature affixed hereon indicates this Engineer's review and participation in the preparation of the Special Provisions.

 6/14/2023	Specifications: Division 1 Special Provisions Kristina B. Nelson, P.E. Senior Program Manager – Engineering, Kitsap County
 6/7/2023	Specifications: Division 1 Special Provisions Masterformat Division 10 – Specialties Masterformat Division 31 – Earthwork Masterformat Division 32 – Exterior Improvements Masterformat Division 33 – Utilities Jeffrey D. Massie, P.E. Otak
 6/7/2023	Specifications: Masterformat Division 32 – Exterior Improvements Masterformat Division 33 – Utilities Robert P. Doherty, P.E. Otak

	Specifications: Masterformat Division 33 – Utilities Daniel P. Carmody, P.E. Otak
	Specifications: Masterformat Division 32 – Exterior Improvements Mark G. Shelby, L.L.A. Otak
 6.05.2023	Specifications: Masterformat Division 03 – Concrete Masterformat Division 05 – Metals Masterformat Division 07 – Thermal and Moisture Protection Masterformat Division 08 – Openings Masterformat Division 09 – Finishes Masterformat Division 10 – Specialties Masterformat Division 11 – Equipment Masterformat Division 12 – Furnishings Brian R. Fleener, R.A. Otak
 06/05/2023	Specifications: Masterformat Division 21 – Fire Suppression Masterformat Division 22 – Plumbing Masterformat Division 23 – Heating, ventilating, and Air Conditioning Masterformat Division 33 – Utilities Darren M. Schwend, P.E. P2S ENG

 SIGNED: 06/06/2023	Specifications: Masterformat Division 26 – Electrical Masterformat Division 27 - Communications Masterformat Division 28 – Electronic Safety and Security Akshay Madhav Prabhu, P.E. P2S ENG
 Signed 06/06/2023	Specifications: Masterformat Division 03 – Concrete Masterformat Division 04 – Masonry Masterformat Division 05 – Metals Masterformat Division 06 – Woods, Plastics, and Composites Kevin Kaplan, P.E. VLMK Engineering + Design

THIS PAGE INTENTIONALLY LEFT BLANK

INTRODUCTION TO THE SPECIAL PROVISIONS

Where referenced in the contract documents, the work on this project shall be accomplished in accordance with the *Standard Specifications for Road, Bridge and Municipal Construction*, 2023 edition, as issued by the Washington State Department of Transportation (WSDOT) and the American Public Works Association (APWA), Washington State Chapter (hereafter "Standard Specifications"). These Special Provisions, as supplemented by the Standard Specifications, shall govern all of the Work.

Also incorporated into the Contract Documents by reference are:

- *Manual on Uniform Traffic Control Devices for Streets and Highways*, currently adopted edition, with Washington State modifications, if any
- *Standard Plans for Road, Bridge and Municipal Construction*, WSDOT/APWA, current edition
- *International Building Code*

Contractor shall obtain copies of these publications, at Contractor's own expense.

THIS PAGE INTENTIONALLY LEFT BLANK

DIVISION 1 GENERAL REQUIREMENTS

Description of Work
This project will construct new facilities at 23026 Route 307/Bond Road NE, Poulsbo, WA 98370 on parcel number 062602-2-064-2007, a 15.64 acre site. Principal items of work include construction of:

- A Household Hazardous Waste Collection Facility building consisting of approximately 9,500 square feet tilt-up concrete structure with structural steel roofing and light gauge stud infill framing, and embedded hydronic heating, comprised of areas for sorting, bulking, storage, reuse, offices, restrooms, containment tank, and loading dock
- A Road Operations Facility building consisting of an approximately 17,900 square foot tilt-up concrete structure with structural steel roofing, light gauge stud infill framing, embedded hydronic heating, and photo-voltaic system, comprised of offices, storage, locker and washroom areas, and vehicle and equipment maintenance shop area
- Generator
- Covered parking
- Covered and uncovered storage areas for equipment and bulk materials
- Vehicle wash system and wash bay structure
- Fueling station
- EV charging stations
- Sander insert rack
- Other site improvements including clearing and grubbing, grading, HMA and concrete surfacing, sidewalk, curb and gutter, storm sewer system including vaults and ponds, utilities, illumination and other site electrical systems, onsite sewage system, landscaping, irrigation, striping, signing, security gates, and fencing and miscellaneous items

1-01 Definitions and Terms

1-01.1 General

The following abbreviations and terms are defined here as they are used in Contract Documents and Specifications. When used in the Proposal Form to denote items of Work and units of measurements, abbreviations are defined to mean the full expression.

1-01.2 Abbreviations

1-01.2(1) Associations and Miscellaneous

AAA	American Arbitration Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AGC	Associated General Contractors of America
AISC	American Institute of Steel Construction

AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMS	Aerospace Material Specification
ANLA	American Nursery and Landscape Association
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
AREMA	American Railway Engineering and Maintenance Association
ARTBA	American Road & Transportation Builders Association
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
ASTM	American Society for Testing and Materials International
AWPA	American Wood Protection Association
AWS	American Welding Society
AWWA	American Water Works Association
CFR	Code of Federal Regulations
CSI	Construction Specifications Institute
CSWGP	National Pollution Discharge System Construction Stormwater General Permit
DIPRA	Ductile Iron Pipe Research Association
ECY	Washington State Department of Ecology
EEI	Edison Electric Institute
EPA	Environmental Protection Agency
ESAL	Equivalent Single Axle Loads
FHWA	Federal Highway Administration
FOP	Field Operating Procedure
IA	Irrigation Association
IBC	International Building Code
ICEA	Insulated Cable Engineers Association
ICRI	International Repair Institute
IEEE	Institute of Electrical and Electronics Engineers
ITE	Institute of Transportation Engineers
IES	Illumination Engineering Society

IMSA	International Municipal Signal Association
MUTCD	Manual on Uniform Traffic Control Devices
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NRMCA	National Ready Mix Concrete Association
OMWBE	Office of Minority and Women's Business Enterprises
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PPI	Plastic Pipe Institute
PTI	Post Tensioning Institute
PCI	Precast/Prestressed Concrete Institute
QPL	Qualified Products List
RAM	Request for Approval of Material
RCW	Revised Code of Washington (Laws of the State)
SAE	Society of Automotive Engineers
SEPA	State Environmental Policy Act
SOP	Standard Operating Procedure
SSPC	Society of Protective Coatings
UL	Underwriters Laboratories
WAC	Washington Administrative Code
WAQTC	Western Alliance for Quality Transportation Construction
WCLIB	West Coast Lumber Inspection Bureau
WISHA	Washington Industrial Safety and Health Administration
WSDOT	Washington State Department of Transportation
WWPA	Western Wood Products Association

1-01.2(2) Items of Work and Units of Measurement

Plans and Specifications may include common engineering and construction abbreviations. Many such abbreviations need no definition. But when the following abbreviations are used, they will only mean:

Agg.	Aggregate
Al.	Aluminum
BST	Bituminous Surface Treatment
Cl.	Class

Cfm	Cubic Feet per Minute
Cfs	Cubic Feet per Second
Comb.	Combination
Conc.	Concrete
CPA	Compaction Price Adjustment
CPF	Composite Pay Factor
Crib.	Cribbing
Culv.	Culvert
cy or cu yd.	Cubic Yard
Diam.	Diameter
Est.	Estimate or Estimated
Excl.	Excluding
F	Fahrenheit
gph	Gallon per Hour
gpm	Gallon per Minute
Hund.	Hundred
HMA	Hot Mix Asphalt
In.	Inch
Incl.	Including
JMCAF	Job Mix Compliance Price Adjustment
JMF	Job Mix Formula
lb	Pound(s)
LF or Lin. Ft.	Linear Foot (Feet)
LS	Lump Sum
M	Thousand
MBM	Thousand Feet Board Measure
MUTS	Minimum Ultimate Tensile Strength
PCPS	Precast Prestressed
Pres.	Pressure
psf	Pounds per Square Foot
psi	Pounds per Square inch
PVC	Polyvinyl Chloride
RAP	Recycled Asphalt Pavement
Reg.	Regulator
Reinf.	Reinforced, Reinforcing

Sec.	Section
St.	Steel
Str.	Structural
sy or sq. yd.	Square Yard(s)
Th.	Thick or Thickness
Tr.	Treatment
Va	Air Voids
VFA	Voids Filled with Asphalt
VMA	Voids in Mineral Aggregate

1-01.3 Definitions

All references in the Standard Specifications or Special Provisions, to the terms “Department of Transportation,” “Washington State Transportation Commission,” “Commission,” “Secretary of Transportation,” “Secretary,” “Headquarters,” and “State Treasurer” shall be revised to read “Contracting Agency.”

All references to the Architect, Engineer, or Owner, shall be revised to read “Contracting Agency.”

All references to the terms “State” or “state” shall be revised to read “Contracting Agency” unless the reference is to an administrative agency of the State of Washington, a State statute or regulation, or the context reasonably indicates otherwise.

All references to “State Materials Laboratory” shall be revised to read “Contracting Agency designated location.”

All references to “final contract voucher certification” shall be interpreted to mean the Contracting Agency form(s) by which final payment is authorized, and final completion and acceptance granted.

Addendum – A written or graphic document, issued to all Bidders and identified as an Addendum prior to Bid opening, which modifies or supplements the Bid Documents and becomes a part of the Contract.

Additive

A supplemental unit of work or group of bid items, identified separately in the Bid Proposal, which may, at the discretion of the Contracting Agency, be awarded in addition to the base bid.

Alternate

One of two or more units of work or groups of bid items, identified separately in the Bid Proposal, from which the Contracting Agency may make a choice between different methods or material of construction for performing the same work.

Award – The formal decision of the Contracting Agency to accept the lowest responsible and responsive Bidder for the Work.

Bid, Proposal – The offer of a Bidder on a properly completed Proposal Form to perform the Contract.

Bidder – An individual, partnership, firm, corporation, or joint venture, submitting a Proposal or Bid. When required by law or otherwise the individual, partnership, firm, corporation, or joint venture shall be prequalified.

Bid Documents – The component parts of the proposed Contract which may include, but are not limited to, the Proposal Form, the proposed Contract Provisions, the proposed Contract Plans, Addenda, and for projects with Contracting Agency subsurface investigations; the Summary of Geotechnical Conditions and subsurface boring logs (if any).

Business Day – A business day is any day from Monday through Friday except holidays as listed in Section 1-08.5.

Call for Bids (Advertisement for Bids) – The published public notice soliciting Proposals or Bids for Work stating, among other things, the time, place, and date for receiving and opening the Bids.

Certified Claim - A written claim filed by the Contractor pursuant to the terms, conditions and requirements of Section 1-09.11(2), after exhausting all the means provided to resolve a dispute, including the use of a Disputes Review Board if one was established.

Cold Weather Protection Period – A period of time 7 days from the day of concrete placement or the duration of the cure period, whichever is longer.

Commission, Washington State Transportation Commission – The appointive body having authority over state transportation matters as provided by law.

Contract – The written agreement between the Contracting Agency and the Contractor. It describes, among other things:

1. What work will be done, and by when;
2. Who provides labor and materials; and
3. How Contractors will be paid.

The Contract includes the Contract (agreement) Form, Bidder's completed Proposal Form, Contract Provisions, Contract Plans, *Standard Specifications*, *Standard Plans*, Addenda, various certifications and affidavits, supplemental agreements, change orders, and subsurface boring logs (if any).

Contract Bond – The approved form of security furnished by the Contractor and the Contractor's Surety as required by the Contract, that guarantees performance of all the Work required by the Contract and payment to anyone who provides supplies or labor for the performance of the Work.

This definition applies to whatever bond form(s) are required by the Contract Documents, which may be a combination of a Payment Bond and a Performance Bond.

Contract Documents

See definition for "Contract."

Contract Form (Agreement Form) – The form provided by the Contracting Agency that requires the authorized signatures of the Contractor and the Contracting Agency to result in formal execution of the Contract.

Contracting Agency – Agency of Government that is responsible for the execution and administration of the Contract.

Contractor – The individual, partnership, firm, corporation, or joint venture, Contracting with the Contracting Agency to do prescribed Work.

Contract Plans – A publication addressing the Work required for an individual project. At the time of the call for Bids, the Contract Plans may include, but are not limited to, the following: a vicinity map, a summary of quantities, structure notes, signing information, traffic control plans, and detailed drawings; all for a specific individual project. At the time of the Contract execution date, the Contract Plans include all Addenda.

Contract Provisions – A publication addressing the Work required for an individual project. At the time of the call for Bids, the Contract Provisions may include, for a specific individual project, the Special Provisions, a listing of the applicable *Standard Plans*, the prevailing minimum hourly wage rates, and an informational Proposal Form with the listing of Bid items. At the time of the Contract execution date, the Contract Provisions include the proposed Contract Provisions and include all Addenda, a copy of the Contract Form, and a copy of the Proposal Form with the Contract prices and extensions.

Contract Time

The period of time established by the terms and conditions of the Contract within which the Work must be physically completed.

Dates

Bid Opening Date

The date on which the Contracting Agency publicly opens and reads the Bids.

Award Date

The date of the formal decision of the Contracting Agency to accept the lowest responsible and responsive Bidder for the Work.

Contract Execution Date

The date the Contracting Agency officially binds the Agency to the Contract.

Notice to Proceed Date

The date stated in the Notice to Proceed on which the Contract time begins.

Substantial Completion Date

The day the Engineer determines the Contracting Agency has full and unrestricted use and benefit of the facilities, both from the operational and safety standpoint, any remaining traffic disruptions will be rare and brief, and only minor incidental work, replacement of temporary substitute facilities, plant establishment periods, or correction or repair remains for the Physical Completion of the total Contract.

Physical Completion Date

The day all of the Work is physically completed on the project. All documentation required by the Contract and required by law does not necessarily need to be furnished by the Contractor by this date.

Completion Date

The day all the Work specified in the Contract is completed and all the obligations of the Contractor under the contract are fulfilled by the Contractor. All documentation required by the Contract and required by law must be furnished by the Contractor before establishment of this date.

Final Acceptance Date

The date on which the Contracting Agency accepts the Work as complete.

Department, Department of Transportation – The State Agency authorized by law to administer transportation-related work.

Engineer – The Contracting Agency's representative who directly supervises the engineering and administration of a construction Contract.

Federal Highway Administration – The Federal Agency authorized to approve plans and contracts for Federal-Aid Highway projects. They also inspect such projects to ensure Contract compliance.

Highway – A public way for vehicles, including the entire Right of Way.

Inspector – The Engineer's representative who inspects Contract performance in detail.

Laboratory – The laboratories of the Contracting Agency, or other laboratories the Contracting Agency authorizes to test Work, soils, and materials.

Notice of Award

The written notice from the Contracting Agency to the successful Bidder signifying the Contracting Agency's acceptance of the Bid Proposal.

Notice to Proceed

The written notice from the Contracting Agency or Engineer to the Contractor authorizing and directing the Contractor to proceed with the Work and establishing the date on which the Contract time begins.

Plans – The Contract Plans or *Standard Plans* which show location, character, and dimensions of prescribed Work including layouts, profiles, cross-sections, and other details.

Project Engineer – Same as Engineer.

Proposal Form – The form provided to Bidders by the Contracting Agency for submittal of a Proposal or Bid to the Contracting Agency for a specific project. The form includes the item number, estimated plan quantity, and item description of the Bid items along with blank spaces to be completed by the Bidder for the unit prices, extensions, the total Bid amount, signatures, date, acknowledgment of Addenda, and the Bidder's address. The required certifications and declarations are part of the form.

Railroad Company – The entity(ies) that own railroads or light rail track, trains, right of way, or equipment that is either within the project limits or is in any way affected by the Contractor's Work. When the Contract does not identify these entities, it shall be the Contractor's responsibility to do so.

Reference Information – Information provided to the Contractor by the Contracting Agency that is not part of the Contract.

Right of Way – Land, property, or property interest, usually in a strip, acquired for or devoted to transportation purposes.

Roadbed – The graded part of the Roadway within top and side slopes, prepared as a foundation for the pavement structure and Shoulders.

Roadside – The area outside the traveled way.

Roadway – The portion of the Right of Way within the outside limits of the side slopes.

Secretary, Secretary of Transportation – The chief executive officer of the Department and other authorized representatives.

Shoulder – The part of the Roadway next to the Traveled Way or Auxiliary Lanes. It provides lateral support of base and surface courses and is an emergency stopping area for vehicles.

Sensitive Area – Natural features, which may be previously altered by human activity, that are present on or adjacent to the project location and protected, managed, or regulated by local, tribal, state, or federal agencies.

Special Provisions – Supplemental Specifications and modifications to the Standard Specifications that apply to an individual project.

Specifications – Provisions and requirements for the prescribed Work.

Standard Plans – A manual of specific plans or drawings adopted by the Contracting Agency which show frequently recurring components of Work that have been standardized for use.

State – The state of Washington acting through its representatives.

Structures – Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, endwalls, buildings, service pipes, sewers, underdrains, foundation drains, and other features found during Work that the Contract may or may not classify as a Structure.

Subgrade – The top surface of the Roadbed on which subbase, base, surfacing, pavement, or layers of similar materials are placed.

Surety – A company that is bound with the Contractor to ensure performance of the Contract, payment of all obligations pertaining to the Work, and fulfillment of such other conditions as are specified in the Contract, Contract Bond, or otherwise required by law.

Traffic

Both vehicular and non-vehicular traffic, such as pedestrians, bicyclists, wheelchairs, and equestrian traffic.

Traveled Way – That part of the Roadway made for vehicle travel excluding Shoulders and Auxiliary Lanes.

Work – The provision of all labor, materials, tools, equipment, and everything needed to successfully complete a project according to the Contract.

Working Drawings – Drawings, plans, diagrams, or supplementary data or calculations, including a schedule of submittal dates for Working Drawings where

specified, which the Contractor must submit to the Engineer.

Written Determination – The official position of the Engineer, in writing, on items including entitlement, instructions, or interpretations. The Written Determination shall be evidenced by a letter or email originating from the Engineer.

WSDOT Form – Forms developed and maintained by WSDOT that are required or available for use on a project. These forms can be downloaded from the forms catalogue at: www.wsdot.wa.gov/forms/pdfforms.html

1-01.4 Interpretations

In the Contract Documents, where appropriate:

1. The singular includes the plural and vice versa; references to statutes or regulations include all statutory or regulatory provisions consolidating, amending, or replacing the statute or regulation referred to.
2. The words “including,” “included,” “includes,” and “include” are deemed to be followed by the words “without limitation “or “but not limited to.”
3. Words defined in Section 1-01.3 apply to all Sections. Words defined in a Section are intended to be used for interpretations within the Section and shall take precedence over the definition in Section 1-01.3. Words not otherwise defined which have well-known technical or construction industry meanings are used in accordance with such recognized meanings.
4. Words of gender used herein include each other gender where appropriate.
5. Unless otherwise specified, lists contained in the Contract Documents defining the Project or the Work shall not be deemed all-inclusive.
6. The titles or headings of the Sections and Subsections herein are intended for convenience of reference and shall not be considered as having any bearing on their interpretation.
7. References to subcontractors of a given tier shall be interpreted to mean the tier in relation to the Contractor. For example, first tier subcontractors all hold a contract directly with the Contractor, known as a first-tier subcontract. Second tier subcontractors all hold a contract with a first-tier subcontractor, known as a second-tier subcontract, and so on.

1-02 Bid Procedures and Conditions

1-02.1 Qualifications of Bidder

Before award of a public works contract, a bidder must meet at least the minimum qualifications of RCW 39.04.350(1) to be considered a responsible bidder and qualified to be awarded a public works project.

1-02.1(1) Supplemental Qualifications Criteria

In addition, the Contracting Agency has established Contracting Agency-specific and/or project-specific supplemental criteria, in accordance with RCW 39.04.350(3), for determining Bidder responsibility, including the basis for evaluation and the deadline for appealing a determination that a Bidder is not responsible.

These criteria are contained in Section 1-02.14 Option C of these Special Provisions.

1-02.2 Plans and Specifications

Information as to where Bid Documents can be obtained or reviewed can be found in the Call for Bids (Advertisement for Bids) for the work.

After award of the contract, plans and specifications will be issued to the Contractor at no cost as detailed below:

To Prime Contractor	No. of Sets	Basis of Distribution
Reduced plans (12" x 18")	3	Furnished automatically upon award.
Contract Provisions	3	Furnished automatically upon award.
Large plans (e.g., 24" x 36")	3	Furnished automatically upon award.

Additional plans and Contract Provisions may be obtained by the Contractor from the source stated in the Call for Bids, at the Contractor's own expense.

1-02.3 Estimated Quantities

The quantities shown in the Proposal Form and the Contract Forms are estimates and are stated only for Bid comparison purposes. The Contracting Agency does not warrant expressly or by implication, that the actual quantities of Work will correspond with those estimates. Payment will be made on the basis of the actual quantities of each item of Work completed in accordance with the Contract requirements.

1-02.4 Examination of Plans, Specifications, and Site of Work

1-02.4(1) General

The Bidder shall carefully examine the Bid Documents as defined in Section 1-01.3. Submittal of a Bid shall be conclusive evidence that the Bidder has made these examinations and understands all requirements for the performance of the completed Work. The Bidder further warrants, agrees, and acknowledges by submitting a Bid that it:

1. Has taken steps reasonably necessary to ascertain the nature and location of the Work;
2. Has investigated and satisfied itself as to the general and local conditions which can affect the Work or its cost, including but not limited to:
   a. Conditions bearing upon acquisition, transportation, disposal, handling, and storage of materials;

b. The availability of labor, materials, water, electric power, and roads;
c. Uncertainties of weather, river stages, tides, critical areas, or similar physical conditions at the site;
d. The conformation and condition of the ground;
e. The character of equipment and facilities needed preliminary to and during Work performance; and
f. The site biological hazards and associated physical hazards.

3. Has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the Work site (including material sites) as well as from the Bid Documents and other information made a part of this Contract; and
4. Has satisfied itself as to the adequacy of time allowed for the completion of the physical Work on the Contract.

Failure of the Bidder to take the actions described and acknowledged in this clause shall not relieve the Bidder from responsibility for estimating properly the difficulty and cost of successfully performing the Work, or from proceeding to successfully perform the Work without additional expense to the Contracting Agency.

The Bidder agrees that the Contracting Agency shall not be liable to it on claims for additional payment or additional time or any claim whatsoever if the claim directly or indirectly results from the Bidder's failure to investigate and familiarize itself sufficiently with the conditions under which the Contract is to be performed.

The Bidder shall be familiar and comply with all Federal, State, tribal, and local laws, ordinances, and regulations which might affect those engaged in the Work. The Contracting Agency will not consider a plea of misunderstanding or ignorance of such requirements.

Bid prices shall reflect what the Bidder anticipates to be the cost of completing the Work, including methods, materials, labor, and equipment. Except as the Contract may provide, the Bidder shall receive no payment for costs that exceed those in the Bid prices.

Prospective Bidders are advised that projects with Work on or adjacent to water may require insurance coverage in compliance with:

1. The Longshoremen's and Harbor Worker's Compensation Act (administered by U.S. Department of Labor), or
2. The State Industrial Insurance (administrated by the Washington State Department of Labor and Industries), or
3. Both.

The Contractor shall bear all cost for such insurance as provided in Section 1-07.10.

No Claim shall be allowed because of ambiguity in the Contract if:

1. The Bidder discovers an ambiguity but fails to notify the Contracting Agency, or
2. The Bidder failed to discover a patent ambiguity that would be discovered by a

reasonably prudent contractor in preparing its Bid.

Any prospective Bidder desiring an explanation or interpretation of the Bid Documents, shall request the explanation or interpretation in writing by close of business 5 business days preceding the bid opening to allow a written reply to reach all prospective Bidders before the submission of their Bids.

Information provided by the Contracting Agency for inspection by the Bidders as Reference Information will be made available for inspection at the location specified in the Special Provisions. The availability of Reference Information from the Contracting Agency shall not relieve the Bidder or the Contractor from risks or their duty to make examinations and investigations as required by this section or other responsibility under the Contract or as may be required by law.

Prospective Bidders are advised that the Contracting Agency may include a partially completed Washington State Department of Ecology (Ecology) Transfer of Coverage (Ecology form ECY 020-87a) for the Construction Stormwater General Permit (CSWGP) as part of the Bid Documents. When the Contracting Agency requires the transfer of coverage of the CSWGP to the Contractor, an informational copy of the Transfer of Coverage and the associated CSWGP will be included in the appendices. As a condition of Section 1-03.3, the Contractor is required to complete sections I, III, and VIII of the Transfer of Coverage and return the form to the Contracting Agency.

The Contracting Agency is responsible for compliance with the CSWGP until the end of day that the Contract is executed. Beginning on the day after the Contract is executed, the Contractor shall assume complete legal responsibility for compliance with the CSWGP and full implementation of all conditions of the CSWGP as they apply to the Contract Work.

1-02.4(2) Subsurface Information

If the Contracting Agency has made a subsurface investigation of the site of the Work, the subsurface information obtained by the Contracting Agency will be made available for inspection by the Bidders as Reference Information. Geotechnical reports and memoranda shall not be considered a part of the contract unless specifically identified as contractual in the Special Provisions. The Summary of Geotechnical Conditions, as an appendix to the Special Provisions, shall be considered as part of the Contract. The boring logs and associated data, as an appendix to the Special Provisions, shall be considered as part of the Contract. The Contracting Agency makes no representation or warranty expressed or implied that:

1. The Bidders' interpretations from the Contract and Reference Information are correct,
2. Moisture conditions and indicated water tables will not vary from those found at the time the subsurface information was collected, and
3. The ground and subsurface conditions at the location of the subsurface information has not been physically disturbed or altered after the subsurface information was obtained.

The Contracting Agency specifically makes no representations, guarantees, or warranties as to the condition, materials, or proportions of the materials between the specific borings regardless of any subsurface information the Contracting Agency may

make available to the prospective Bidders.

The availability of subsurface information from the Contracting Agency shall not relieve the Bidder or the Contractor from risks or of their duty to make examinations and investigations as required by Section 1-02.4(1) or other responsibility under the Contract or as may be required by law.

1-02.5 Proposal Forms

The Proposal Form will identify the project and its location and describe the work. It will also list estimated quantities, units of measurement, the items of work, and the materials to be furnished at the unit bid prices. The bidder shall complete spaces on the proposal form that call for, but are not limited to, unit prices; extensions; summations; the total bid amount; signatures; date; and, where applicable, retail sales taxes and acknowledgment of addenda; the bidder's name, address, telephone number, and signature; a State of Washington Contractor's Registration Number; and a Business License Number, if applicable. Bids shall be completed by typing or shall be printed in ink by hand, preferably in black ink. The required certifications are included as part of the Proposal Form.

The Contracting Agency reserves the right to arrange the proposal forms with alternates and additives, if such be to the advantage of the Contracting Agency. The bidder shall bid on all alternates and additives set forth in the Proposal Form unless otherwise specified.

1-02.6 Preparation of Proposal

The Contracting Agency will accept only those Proposals properly executed on the physical forms it provides, or electronic forms that the Bidder has been authorized to access. Unless it approves in writing, the Contracting Agency will not accept Proposals on forms attached to the Plans and stamped "Informational."

All prices shall be in legible figures (not words) written in ink or typed, and expressed in U.S. dollars and cents. The Proposal shall include:

1. A unit price for each item (omitting digits more than two places to the right of the decimal point),
2. An extension for each unit price (omitting digits more than two places to the right of the decimal point), and
3. The total Contract price (the sum of all extensions).
4. If a minimum bid amount has been established for any item, the unit or lump sum price must equal or exceed the minimum amount stated.
5. Any correction to a bid made by interlineation, alteration, or erasure, shall be initialed by the signer of the bid.

In the space provided on the signature sheet, the Bidder shall confirm that all Addenda have been received.

The Bidder shall submit with the Bid a list of:

1. Subcontractors who will perform the work of structural steel installation, rebar

installation, heating, ventilation, air conditioning, and plumbing as described in RCW 18.106 and electrical as described in RCW 19.28, and

2. The Work those subcontractors will perform on the Contract as described in RCW 39.30.060.
3. Shall not list more than one subcontractor for each category of work identified, except, when subcontractors vary with Bid alternates, in which case the Bidder shall identify which subcontractor will be used for which alternate.

If no subcontractor is listed, the Bidder acknowledges that it does not intend to use any subcontractor to perform those items of work.

The Bidder shall submit with their Bid a completed Contractor Certification Wage Law Compliance form, provided by the Contracting Agency. Failure to return this certification as part of the Bid Proposal package will make this Bid Nonresponsive and ineligible for Award. A Contractor Certification of Wage Law Compliance form is included in the Proposal Forms.

The Bidder shall make no stipulation on the Bid Form, nor qualify the bid in any manner.

A bid by a corporation shall be executed in the corporate name, by the president or a vice president (or other corporate officer accompanied by evidence of authority to sign).

A bid by a partnership shall be executed in the partnership name, and signed by a partner. A copy of the partnership agreement shall be submitted with the Bid Form.

A bid by a joint venture shall be executed in the joint venture name and signed by a member of the joint venture. A copy of the joint venture agreement shall be submitted with the Bid Form.

Cumulative Alternates Bidding

The Bid Proposal for this Contract requires the Bidder to bid cumulative Alternates as part of the bid. As such the Bidder is required to submit a Base Bid and a bid for each of the Alternate(s).

Bid Proposal

The Bid Proposal includes the following:

1. Base Bid
   The Base Bid shall include constructing all items included in the Proposal *except* those items contained in the Alternate(s).

2. Alternate(s)

   a. Alternate
      Based on constructing (*** Photo-voltaic System – Added Capacity ***)
      The Bid items for Alternate 1 are as listed in the Bid Proposal.

Bidding Procedures

To be considered responsive the Bidder shall submit a price on each and every Bid item included in the Base Bid and all Alternate(s.)

The successful Bidder will be the Bidder submitting the lowest responsible Bid for the highest order Preference that is within the amount of available funds for the project. Available funds will be announced immediately prior to the opening of Bids. The following are listed in order from highest to lowest Preference:

Preference 1: Lowest total for Base Bid plus Alternate 1.

Preference 2: Lowest total for Base Bid.

The Contracting Agency may, at their discretion, award a Contract for the Base Bid, without any additional Alternates, in the event that all Bids exceed the available funds announced. In any case, the award will be subject to the requirements of Section 1-03.

1-02.6(1) Recycled Materials Proposal

The Bidder shall submit with the Bid, its proposal for incorporating recycled materials into the project, using the form provided in the Contract Provisions.

1-02.7 Bid Deposit

A deposit of at least 5 percent of the total Bid shall accompany each Bid. This deposit may be cash, certified check, cashier's check, or a proposal bond (Surety bond). When a physical Bid deposit or proposal bond is furnished to accompany an electronic Proposal Form, the Bid deposit shall be received by the Contracting Agency at the location specified for receipt of Bids prior to the time set for receipt of Bids. Proposal bonds shall be on a form acceptable to the Contracting Agency and shall be signed by the Bidder and the Surety. A proposal bond shall not be conditioned in any way to modify the minimum 5 percent required. The Surety shall: (1) be registered with the Washington State Insurance Commissioner, and (2) appear on the current Authorized Insurance List in the State of Washington published by the Office of the Insurance Commissioner.

The failure to furnish a Bid deposit of a minimum of 5 percent with the Bid or as a physical supplement to the electronic Proposal Form shall make the Bid nonresponsive and shall cause the Bid to be rejected by the Contracting Agency.

Bid bonds shall contain the following:

1. Contracting Agency-assigned number for the project;
2. Name of the project;
3. The Contracting Agency named as obligee;
4. The amount of the bid bond stated either as a dollar figure or as a percentage which represents five percent of the maximum bid amount that could be awarded;

5. Signature of the bidder's officer empowered to sign official statements. The signature of the person authorized to submit the bid should agree with the signature on the bond, and the title of the person must accompany the said signature;
6. The signature of the surety's officer empowered to sign the bond and the power of attorney.

Bidder must use the bond form included in the Contract Provisions.

Cash will not be accepted for a bid deposit.

1-02.8 Noncollusion Declaration and Lobbying Certification

1-02.8(1) Noncollusion Declaration

When required by Section 112(c) Title 23, United States Code, a declaration shall be provided certifying that the Bidder has not taken part in collusion or other action that would restrain competitive Bidding.

The Code of Federal Regulations 23 CFR 635.112(f)(1) requires that: "Each Bidder shall file a sworn or unsworn statement executed by, or on behalf of the person, firm, association, or corporation submitting the Bid, certifying that such persons, firm, association, or corporation has not either directly or indirectly, entered into any agreement, participated in collusion, or otherwise taken action in restraint of free competitive Bidding in connection with the submitted Bid. Failure to submit the sworn or unsworn statement as part of the Bid Proposal package will make the Bid nonresponsive and not eligible for Award consideration." In addition, 23 CFR 635.112(f)(1) requires that the Contracting Agency provide the form for the declaration to prospective Bidders and that the declaration shall be executed by such persons, firm, association, or corporation under penalty of perjury under the laws of the United States.

Therefore, by including the Non-collusion Declaration as part of the signed bid Proposal, the Bidder is deemed to have certified and agreed to the requirements of the Declaration.

1-02.8(2) Lobbying Certification

Section 319 of Public Law 101-121 prohibits payment of Federal Funds for contract lobbying by the Contractor and any subcontractor whose contract exceeds $100,000. A Certification for Federal-Aid Contracts (WSDOT Form 272-040) is provided in the Proposal Form for Contracts exceeding $100,000 to address this requirement.

By signing the proposal, the Bidder will be deemed to have signed and agreed to the conditions and requirements of the Certification for Federal-Aid Contracts.

The Contractor shall ensure that a Certification for Federal-Aid Contracts (WSDOT Form 272-040) is included in every contract with any subcontractor whose contract exceeds $100,000. By signing the contract any subcontractor will be deemed to have signed and agreed to the conditions and requirements of the Certification for Federal-Aid Contracts. The Contractor shall keep evidence in their files that such subcontractor has committed to this requirement.

Section 319 of Public Law 101-121 also provides that, if any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of a Federal agency, a Member of

Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal Contract, grant, loan, or cooperative agreement, the Contractor shall complete and submit to the Contracting Agency the current version of Standard Form LLL, DISCLOSURE OF LOBBYING ACTIVITIES, in accordance with the instructions on the form. All subcontractors whose contract exceeds $100,000 shall disclose in the same manner as the Contractor, except that, Standard Form LLL shall be submitted to the Contractor for processing to the Contracting Agency. Standard Form LLL is available for download at www.gsa.gov/reference/forms.

Audits will be conducted to ensure compliance with this section.

1-02.9 Delivery of Proposal

Each Proposal shall be submitted in a sealed envelope, with the Project Name and Project Number as stated in the Call for Bids clearly marked on the outside of the envelope, or as otherwise required in the Bid Documents, to ensure proper handling and delivery.

Proposals that are received as required will be publicly opened and read as specified in Section 1-02.12. The Contracting Agency will not open or consider any Bid Proposal that is received after the time specified in the Call for Bids for receipt of Bid Proposals, or received in a location other than that specified in the Call for Bids.

If an emergency or unanticipated event interrupts normal work processes of the Contracting Agency so that Proposals cannot be received at the office designated for receipt of bids as specified in Section 1-02.12 the time specified for receipt of the Proposal will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which the normal work processes of the Contracting Agency resume.

1-02.10 Withdrawing, Revising, or Supplementing Proposal

After submitting a physical Bid Proposal to the Contracting Agency, the Bidder may withdraw, revise, or supplement it if:

1. The Bidder submits a written request signed by an authorized person and physically delivers it to the place designated for receipt of Bid Proposals, and
2. The Contracting Agency receives the request before the time set for receipt of Bid Proposals, and
3. The revised or supplemented Bid Proposal (if any) is received by the Contracting Agency before the time set for receipt of Bid Proposals.

If the Bidder's request to withdraw, revise, or supplement its Bid Proposal is received before the time set for receipt of Bid Proposals, the Contracting Agency will return the unopened Proposal package to the Bidder. The Bidder must then submit the revised or supplemented package in its entirety. If the Bidder does not submit a revised or supplemented package, then its bid shall be considered withdrawn.

Late revised or supplemented Bid Proposals or late withdrawal requests will be date recorded by the Contracting Agency and returned unopened. Mailed, emailed, or faxed requests to withdraw, revise, or supplement a Bid Proposal are not acceptable.

1-02.11 Vacant

1-02.12 Public Opening of Proposals

Proposals will be opened and publicly read at the time indicated in the call for Bids unless the Bid opening has been delayed or canceled. Bidders, their authorized agents, and other interested parties are invited to be present.

If an emergency or unanticipated event interrupts normal work processes of the Contracting Agency so that Proposals cannot be opened at the time indicated in the call for Bids the time specified for opening of Proposals will be deemed to be extended to the same time of day on the first workday on which the normal work processes of the Contracting Agency resume.

1-02.13 Irregular Proposals

1. A Proposal will be considered irregular and will be rejected if:
   a. The Bidder is not prequalified when so required;
   b. The authorized Proposal form furnished by the Contracting Agency is not used or is altered;
   c. The completed Proposal form contains any unauthorized additions, deletions, alternate Bids, or conditions;
   d. The Bidder adds provisions reserving the right to reject or accept the award, or enter into the Contract;
   e. A price per unit cannot be determined from the Bid Proposal;
   f. The Proposal form is not properly executed;
   g. The Bidder fails to submit or properly complete a Subcontractor list, if applicable, as required in Section 1-02.6;
   h. The Bid Proposal does not constitute a definite and unqualified offer to meet the material terms of the Bid invitation; or
   i. More than one Proposal is submitted for the same project from a Bidder under the same or different names.
2. A Proposal may be considered irregular and may be rejected if:
   a. The Proposal does not include a unit price for every Bid item;
   b. Any of the unit prices are excessively unbalanced (either above or below the amount of a reasonable Bid) to the potential detriment of the Contracting Agency;
   c. Receipt of Addenda is not acknowledged;
   d. A member of a joint venture or partnership and the joint venture or partnership submit Proposals for the same project (in such an instance, both Bids may be rejected); or
   e. If Proposal form entries are not made in ink.

1-02.14 Disqualification of Bidders

A Bidder will be deemed not responsible if the Bidder does not meet the mandatory bidder responsibility criteria in RCW 39.04.350(1), as amended; or does not meet Supplemental Criteria 1-8 in this Section:

The Contracting Agency will verify that the Bidder meets the mandatory bidder responsibility criteria in RCW 39.04.350(1), and Supplemental Criteria 1-2. Evidence that the

Bidder meets Supplemental Criteria 3-8 shall be provided by the Bidder as stated later in this Section.

1. **Delinquent State Taxes**

   A. Criterion: The Bidder shall not owe delinquent taxes to the Washington State Department of Revenue without a payment plan approved by the Department of Revenue.

   B. Documentation: The Bidder, if and when required as detailed below, shall sign a statement (on a form to be provided by the Contracting Agency) that the Bidder does not owe delinquent taxes to the Washington State Department of Revenue, or if delinquent taxes are owed to the Washington State Department of Revenue, the Bidder must submit a written payment plan approved by the Department of Revenue, to the Contracting Agency by the deadline listed below.

2. **Federal Debarment**

   A. Criterion: The Bidder shall not currently be debarred or suspended by the Federal government.

   B. Documentation: The Bidder shall not be listed as having an "active exclusion" on the U.S. government's "System for Award Management" database (www.sam.gov).

3. **Subcontractor Responsibility**

   A. Criterion: The Bidder's standard subcontract form shall include the subcontractor responsibility language required by RCW 39.06.020, and the Bidder shall have an established procedure which it utilizes to validate the responsibility of each of its subcontractors. The Bidder's subcontract form shall also include a requirement that each of its subcontractors shall have and document a similar procedure to determine whether the sub-tier subcontractors with whom it contracts are also "responsible" subcontractors as defined by RCW 39.06.020.

   B. Documentation: The Bidder, if and when required as detailed below, shall submit a copy of its standard subcontract form for review by the Contracting Agency, and a written description of its procedure for validating the responsibility of subcontractors with which it contracts.

4. **Claims Against Retainage and Bonds**

   A. Criterion: The Bidder shall not have a record of excessive claims filed against the retainage or payment bonds for public works projects in the three years prior to the bid submittal date, that demonstrate a lack of effective management by the Bidder of making timely and appropriate payments to its subcontractors, suppliers, and workers, unless there are extenuating circumstances and such circumstances are deemed acceptable to the Contracting Agency.

   B. Documentation: The Bidder, if and when required as detailed below, shall submit a list of the public works projects completed in the three years prior to the bid submittal date that have had claims against retainage and bonds and include for each project the following information:

- Name of project
- The owner and contact information for the owner;
- A list of claims filed against the retainage and/or payment bond for any of the projects listed;
- A written explanation of the circumstances surrounding each claim and the ultimate resolution of the claim.

5. **Public Bidding Crime**

   A. Criterion: The Bidder and/or its owners shall not have been convicted of a crime involving bidding on a public works contract in the five years prior to the bid submittal date.

   B. Documentation: The Bidder, if and when required as detailed below, shall sign a statement (on a form to be provided by the Contracting Agency) that th0 bidding on a public works contract.

6. **Termination for Cause / Termination for Default**

   A. Criterion: The Bidder shall not have had any public works contract terminated for cause or terminated for default by a government agency in the five years prior to the bid submittal date, unless there are extenuating circumstances and such circumstances are deemed acceptable to the Contracting Agency.

   B. Documentation: The Bidder, if and when required as detailed below, shall sign a statement (on a form to be provided by the Contracting Agency) that the Bidder has not had any public works contract terminated for cause or terminated for default by a government agency in the five years prior to the bid submittal date; or if Bidder was terminated, describe the circumstances.

7. **Lawsuits**

   A. Criterion: The Bidder shall not have lawsuits with judgments entered against the Bidder in the five years prior to the bid submittal date that demonstrate a pattern of failing to meet the terms of contracts, unless there are extenuating circumstances and such circumstances are deemed acceptable to the Contracting Agency.

   B. Documentation: The Bidder, if and when required as detailed below, shall sign a statement (on a form to be provided by the Contracting Agency) that the Bidder has not had any lawsuits with judgments entered against the Bidder in the five years prior to the bid submittal date that demonstrate a pattern of failing to meet the terms of contracts, or shall submit a list of all lawsuits with judgments entered against the Bidder in the five years prior to the bid submittal date, along with a written explanation of the circumstances surrounding each such lawsuit. The Contracting Agency shall evaluate these explanations to determine whether the lawsuits demonstrate a pattern of failing to meet of terms of construction related contracts.

8. **Contracting Agency Specific Criteria**

A. Criterion: Bidders shall supply the following information:
    1. Dollar amount of contracts currently held by the bidder,
    2. List of more important construction projects completed by your company in the last 5 years,
    3. Bank references
    4. Bonding company, and
    5. Statement of Qualifications for Contractor Personnel.

B. Documentation: The required information shall be included in Section C of the Bidder Responsibility Statement.

As evidence that the Bidder meets the Supplemental Responsibility Criteria stated above, the apparent low Bidder must submit to the Contracting Agency by 12:00 P.M. (noon) of the second business day following the bid submittal deadline, a written statement verifying that the Bidder meets the Supplemental Criteria together with supporting documentation (sufficient in the sole judgment of the Contracting Agency) demonstrating compliance with the Supplemental Responsibility Criteria. The Contracting Agency reserves the right to request further documentation as needed from the low bidder and documentation from other Bidders as well to assess Bidder responsibility and compliance with all bidder responsibility criteria. The Contracting Agency also reserves the right to obtain information from third-parties and independent sources of information concerning a Bidder's compliance with the mandatory and supplemental criteria, and to use that information in their evaluation. The Contracting Agency may consider mitigating factors in determining whether the Bidder complies with the requirements of the Supplemental Criteria.

The basis for evaluation of Bidder compliance with these mandatory and Supplemental Criteria shall include any documents or facts obtained by Contracting Agency (whether from the Bidder or third parties) including but not limited to: (i) financial, historical, or operational data from the Bidder; (ii) information obtained directly by the Contracting Agency from others for whom the Bidder has worked, or other public agencies or private enterprises; and (iii) any additional information obtained by the Contracting Agency which is believed to be relevant to the matter.

If the Contracting Agency determines the Bidder does not meet the bidder responsibility criteria above and is therefore not a responsible Bidder, the Contracting Agency shall notify the Bidder in writing, with the reasons for its determination. If the Bidder disagrees with this determination, it may appeal the determination within two (2) business days of the Contracting Agency's determination by presenting its appeal and any additional information to the Contracting Agency. The Contracting Agency will consider the appeal and any additional information before issuing its final determination. If the final determination affirms that the Bidder is not responsible, the Contracting Agency will not execute a contract with any other Bidder until at least two business days after the Bidder determined to be not responsible has received the Contracting Agency's final determination.

Request to Change Supplemental Bidder Responsibility Criteria Prior To Bid: Bidders with concerns about the relevancy or restrictiveness of the Supplemental Bidder

Responsibility Criteria may make or submit requests to the Contracting Agency to modify the criteria. Such requests shall be in writing, describe the nature of the concerns, and propose specific modifications to the criteria. Bidders shall submit such requests to the Contracting Agency no later than five (5) business days prior to the bid submittal deadline and address the request to the Project Engineer or such other person designated by the Contracting Agency in the Bid Documents.

A bidder will be deemed not responsible for failing to:

- Submit and meet the requirements of the "Statement of Qualifications for Contractor Personnel" form included in the Contract Documents.

1-02.15 Pre-Award Information

Before awarding any contract, the Contracting Agency may require one or more of these items or actions of the apparent lowest responsible bidder:

1. A complete statement of the origin, composition, and manufacture of any or all materials to be used,
2. Samples of these materials for quality and fitness tests,
3. A progress schedule (in a form the Contracting Agency requires) showing the order of and time required for the various phases of the work,
4. A breakdown of costs assigned to any bid item,
5. Attendance at a conference with the Engineer or representatives of the Engineer,
6. Obtain, and furnish a copy of, a business license to do business in the city or county where the work is located.
7. Any other information or action taken that is deemed necessary to ensure that the bidder is the lowest responsible bidder.

1-03 Award and Execution of Contract

1-03.1 Consideration of Bids

After opening and reading proposals, the Contracting Agency will check them for correctness of extensions of the prices per unit and the total price. If a discrepancy exists between the price per unit and the extended amount of any bid item, the price per unit will control. If a minimum bid amount has been established for any item and the bidder's unit or lump sum price is less than the minimum specified amount, the Contracting Agency will unilaterally revise the unit or lump sum price, to the minimum specified amount and recalculate the extension. The total of extensions, corrected where necessary, including sales taxes where applicable and such additives and/or alternates as selected by the Contracting Agency, will be used by the Contracting Agency for award purposes and to fix the Awarded Contract Price amount and the amount of the contract bond.

The right is reserved by the Contracting Agency to waive informalities in the bidding, accept a Proposal of the lowest responsible Bidder, reject any or all Bids, republish the call for Bids, revise or cancel the Work, or require the Work to be done in another way if the best interest of the Contracting Agency is served.

A Bidder who wishes to claim error after the Bids have been publicly opened and read as required by RCW 47.28.090 shall promptly notify the Contracting Agency that an error occurred. The Bidder shall submit a notarized affidavit or declaration under penalty of perjury signed by the Bidder and accompanied by the work sheets used in the preparation of the Bid, requesting relief from the responsibilities of Award. The affidavit or declaration shall describe the specific error(s) and certify that the work sheets are the ones used in preparing the Bid.

The affidavit or declaration shall be submitted no later than 5:00 p.m. on the first business day after Bid opening or the claim will not be considered. The Contracting Agency will review the affidavit or declaration and the certified work sheets to determine the validity of the claimed error and if the error is of the kind for which the law allows relief from forfeiture of the Bid deposit. If the Contracting Agency concurs in the claim of error and determines that the error is of the kind that allows relief from forfeiture, the Bidder will be relieved of responsibility and the Bid deposit of the Bidder will be returned. If the Contracting Agency does not concur in the error or determines that the error is not the kind for which the law allows relief, the Contracting Agency may Award the Contract and if the Bidder refuses to execute the Contract, the Bidder's Bid deposit shall be forfeited as required by RCW 47.28.100.

1-03.1(1) Identical Bid Totals

After opening Bids, if two or more lowest responsive Bid totals are exactly equal, then the tie-breaker will be the Bidder with an equal lowest bid, that proposed to use the highest percentage of recycled materials in the Project, per the form submitted with the Bid Proposal. If those percentages are also exactly equal, then the tiebreaker will be determined by drawing as follows: Two or more slips of paper will be marked as follows: one marked "Winner" and the other(s) marked "unsuccessful." The slips will be folded to make the marking unseen. The slips will be placed inside a box. One authorized representative of each Bidder shall draw a slip from the box. Bidders shall draw in alphabetic order by the name of the firm as registered with the Washington State Department of Licensing. The slips shall be unfolded and the firm with the slip marked "Winner" will be determined to be the successful Bidder and eligible for Award of the Contract. Only those Bidders who submitted a Bid total that is exactly equal to the lowest responsive Bid, and with a proposed recycled materials percentage that is exactly equal to the highest proposed recycled materials amount, are eligible to draw.

1-03.2 Award of Contract

Normally, Contract Award or Bid rejection will occur within 45 calendar days after Bid opening. If the lowest responsible Bidder and the Contracting Agency agree, this deadline may be extended. If they cannot agree on an extension by the 45 calendar day deadline, the Contracting Agency reserves the right to Award the Contract to the next lowest responsible Bidder or reject all Bids. The Contracting Agency will notify the successful Bidder of the Contract Award in writing.

1-03.3 Execution of Contract

Within 3 calendar days of Award date (not including Saturdays, Sundays and Holidays), the successful Bidder shall provide the information necessary to execute the Contract to the Contracting Agency. The Bidder shall send the contact information, including the full

name, email address, and phone number, for the authorized signer and bonding agent to the Contracting Agency.

Copies of the Contract Provisions, including the unsigned Form of Contract, will be available for signature by the successful bidder on the first business day following award. The number of copies to be executed by the Contractor will be determined by the Contracting Agency.

Within 10 calendar days after the award date, the successful bidder shall return the signed Contracting Agency-prepared contract, an insurance certification as required by Section 1-07.18, a satisfactory bond as required by law and Section 1-03.4, the Transfer of Coverage form for the Construction Stormwater General Permit with sections I, III, and VIII completed when provided. Before execution of the contract by the Contracting Agency, the successful bidder shall provide any pre-award information the Contracting Agency may require under Section 1-02.15.

Until the Contracting Agency executes a contract, no proposal shall bind the Contracting Agency nor shall any work begin within the project limits or within Contracting Agency-furnished sites. The Contractor shall bear all risks for any work begun outside such areas and for any materials ordered before the contract is executed by the Contracting Agency.

If the bidder experiences circumstances beyond their control that prevents return of the contract documents within the calendar days after the award date stated above, the Contracting Agency may grant up to a maximum of 10 additional calendar days for return of the documents, provided the Contracting Agency deems the circumstances warrant it.

1-03.4 Contract Bond

The successful bidder shall provide executed payment and performance bond(s) for the full contract amount. The bond may be a combined payment and performance bond; or be separate payment and performance bonds. In the case of separate payment and performance bonds, each shall be for the full contract amount. The bond(s) shall:

1. Be on Contracting Agency-furnished form(s);
2. Be signed by an approved surety (or sureties) that:
   a. Is registered with the Washington State Insurance Commissioner, and
   b. Appears on the current Authorized Insurance List in the State of Washington published by the Office of the Insurance Commissioner,
3. Guarantee that the Contractor will perform and comply with all obligations, duties, and conditions under the Contract, including but not limited to the duty and obligation to indemnify, defend, and protect the Contracting Agency against all losses and claims related directly or indirectly from any failure:
   a. Of the Contractor (or any of the employees, subcontractors, or lower tier subcontractors of the Contractor) to faithfully perform and comply with all contract obligations, conditions, and duties, or

b. Of the Contractor (or the subcontractors or lower tier subcontractors of the Contractor) to pay all laborers, mechanics, subcontractors, lower tier subcontractors, material person, or any other person who provides supplies or provisions for carrying out the work;

4. Be conditioned upon the payment of taxes, increases, and penalties incurred on the project under titles 50, 51, and 82 RCW; and
5. Be accompanied by a power of attorney for the Surety's officer empowered to sign the bond; and
6. Be signed by an officer of the Contractor empowered to sign official statements (sole proprietor or partner). If the Contractor is a corporation, the bond(s) must be signed by the president or vice president, unless accompanied by written proof of the authority of the individual signing the bond(s) to bind the corporation (i.e., corporate resolution, power of attorney, or a letter to such effect signed by the president or vice president).

The Contracting Agency may require Sureties or Surety companies on the Contract Bond to appear and qualify themselves. Whenever the Contracting Agency deems the Surety or Sureties to be inadequate, it may, upon written demand, require the Contractor to furnish additional Surety to cover all remaining Work. Until the added Surety is furnished, payments on the Contract will stop.

1-03.5 Failure to Execute Contract

Failure to return the insurance certification and bond with the signed Contract as required in Section 1-03.3, or failure to provide Disadvantaged, Minority or Women's Business Enterprise information if required in the Contract, or failure or refusal to sign the Contract, or failure to register as a contractor in the state of Washington, or failure to return the completed Transfer of Coverage for the Construction Stormwater General Permit to the Contracting Agency when provided shall result in forfeiture of the proposal bond or deposit of this Bidder. If this should occur, the Contracting Agency may then Award the Contract to the second lowest responsible Bidder or reject all remaining Bids. If the second lowest responsible Bidder fails to return the required documents as stated above within the time provided after Award, the Contract may then be Awarded successively in a like manner to the remaining lowest responsible Bidders until the above requirements are met or the remaining Proposals are rejected.

1-03.6 Return of Bid Deposit

When Proposals have been examined and corrected as necessary, proposal bonds and deposits accompanying Proposals ineligible for further consideration will be returned. All other proposal bonds and deposits will be held until the Contract has been properly executed. When the Contract has been properly executed, all remaining deposits or bonds, except those subject to forfeiture, will be returned.

1-03.7 Judicial Review

Any decision made by the Contracting Agency regarding the Award and execution of the Contract or Bid rejection shall be conclusive subject to the scope of judicial review permitted under Washington Law. Such review, if any, shall be timely filed in the Superior Court of the county where the Contracting Agency headquarters is located,

provided that where an action is asserted against a county, RCW 36.01.050 shall control venue and jurisdiction.

1-04 Scope of the Work

1-04.1 Intent of the Contract

The intent of the Contract is to prescribe a complete Work. Omissions from the Contract of details of Work that are necessary to carry out the intent of the Contract shall not relieve the Contractor from performing the omitted Work.

1-04.2 Coordination of Contract Documents, Plans, Special Provisions, Specifications, and Addenda

The complete Contract includes these parts: the Contract Form, Bidder's completed Proposal Form, Contract Plans, Contract Provisions, Standard Specifications, *Standard Plans*, Addenda, various certifications and affidavits, supplemental agreements, change orders, and subsurface boring logs (if any). These parts complement each other in describing a complete Work. Any requirement in one part binds as if stated in all parts. The Contractor shall provide all Work or materials clearly implied in the Contract even if the Contract does not mention it specifically.

Any inconsistency in the parts of the contract shall be resolved by following this order of precedence (e.g., 1 presiding over 2, 2 over 3, 3 over 4, and so forth):

1. Addenda,
2. Proposal Form,
3. Special Provisions,
4. Contract Plans,
5. Standard Specifications,
6. Contracting Agency's Standard Plans or Details (if any), and
7. WSDOT Standard Plans for Road, Bridge, and Municipal Construction.

On the Contract Plans, Working Drawings, and *Standard Plans,* figured dimensions shall take precedence over scaled dimensions.

This order of precedence shall not apply when Work is required by one part of the Contract but omitted from another part or parts of the Contract. The Work required in one part must be furnished even if not mentioned in other parts of the Contract.

Whenever reference is made in these Special Provisions to codes, rules, specifications, and standards, the reference shall be construed to mean the code, rule, specification, or standard that is in effect on the Bid advertisement date, unless otherwise stated or as required by law.

If any part of the Contract requires Work that does not include a description for how the Work is to be performed, the Work shall be performed in accordance with standard trade practice(s). For purposes of the Contract, a standard trade practice is one having such regularity of observance in the trade as to justify an expectation that it will be observed by the Contractor in doing the Work.

In case of ambiguities or disputes over interpreting the Contract, the Engineer's decision will be final as provided in Section 1-05.1.

1-04.3 Reference Information

Reference Information provided to the Contractor is not part of the Contract. The Contracting Agency does not guarantee the accuracy of the Reference Information and is not responsible for the content of the Reference Information in any manner. Any use of Reference Information by the Contractor is done solely at the Contractor's risk.

1-04.4 Changes

The Engineer reserves the right to make, at any time during the Work, such changes in quantities and such alterations in the Work as are necessary to satisfactorily complete the project. Such changes in quantities and alterations shall not invalidate the Contract nor release the Surety, and the Contractor agrees to perform the Work as altered. Among others, these changes and alterations may include:

1. Deleting any part of the Work.
2. Increasing or decreasing quantities.
3. Altering Specifications, designs, or both.
4. Altering the way the Work is to be done.
5. Adding new Work.
6. Altering facilities, equipment, materials, services, or sites, provided by the Contracting Agency.
7. Ordering the Contractor to speed up or delay the Work.

The Engineer will issue a written change order for changes unless the remainder of this section provides otherwise.

If the alterations or changes in quantities significantly change the character of the Work under the Contract, whether or not changed by any such different quantities or alterations, an adjustment, excluding loss of anticipated profits, will be made to the Contract. The basis for the adjustment shall be agreed upon prior to the performance of the Work. If a basis cannot be agreed upon, then an adjustment will be made either for or against the Contractor in such amount as the Engineer may determine to be fair and equitable. If the alterations or changes in quantities do not significantly change the character of the Work to be performed under the Contract, the altered Work will be paid for as provided elsewhere in the Contract. The term *significant change* shall be construed to apply only to the following circumstances:

A. When the character of the Work as altered differs materially in kind or nature from that involved or included in the original proposed construction; or

B. When an item of Work, as defined elsewhere in the Contract, is increased in excess of 125 percent or decreased below 75 percent of the original Contract quantity. For the purpose of this Section, an item of Work will be defined as any item that qualifies for adjustment under the provisions of Section 1-04.6.

For item 1, an equitable adjustment for deleted Work will be made as provided in Section 1-09.4.

For item 2, if the actual quantity of an item, exclusive of added or deleted amounts included in agreed change orders, increases or decreases by more than 25 percent from the original Plan quantity, the unit Contract prices for that item may be adjusted in accordance with Section 1-04.6.

For all changes except item 1 (deleted Work) or item 2 (increasing or decreasing quantities), the Engineer will determine if the change should be paid for at unit Contract price(s). If the Engineer determines that the change increased or decreased the Contractor's costs or time to do any of the Work including unchanged Work, the Engineer will make an equitable adjustment to the Contract. The equitable adjustment will be by agreement with the Contractor. However, if the parties are unable to agree, the Engineer will determine the amount of the equitable adjustment in accordance with Section 1-09.4 and adjust the time as the Engineer deems appropriate. Extensions of time will be evaluated in accordance with Section 1-08.8. The Engineer's decision concerning equitable adjustment and extension of time shall be final as provided in Section 1-05.1.

The Contractor shall proceed with the Work upon receiving:

1. A written change order approved by the Engineer, or
2. An oral order from the Engineer before receiving the written change order.

Within 14 calendar days of delivery of the change order the contractor shall endorse and return the change order, request an extension of time for endorsement or respond in accordance with Section 1-04.5. The Contracting Agency may unilaterally process the change order if the Contractor fails to comply with these requirements or when the Contractor protests in accordance with Section 1-04.5. Changes normally noted on field stakes or variations from estimated quantities, except as provided in subparagraph A or B above, will not require a written change order. These changes shall be made at the unit prices that apply. The Contractor shall respond immediately to changes shown on field stakes without waiting for further notice.

The Contractor accepts all requirements of a change order by: (1) endorsing it, (2) not responding within the allotted time, or (3) not protesting in accordance with Section 1-04.5. A change order that is not protested in accordance with Section 1-04.5 shall be full payment and final settlement of all claims for Contract time and for all costs of any kind, including costs of delays, related to Work either covered or affected by the change.

The Contractor shall obtain written consent of the Surety or Sureties if the Engineer requests such consent.

Within 21 days of execution of the Contract, the Contractor shall submit a Type 1 Working Drawing consisting of the names, email addresses, and text-message capable phone numbers for the authorized change order signers and shall bear the name, phone number and email of the officer providing this authorization. Delegation of authority to sign Change Orders shall be by the officer authorized to sign the Contract in accordance with Section 1-02.1.

1-04.4(1) Minor Changes

Payments or credits for changes amounting to $25,000 or less may be made under the

Bid item “Minor Change”. At the discretion of the Contracting Agency, this procedure for Minor Changes may be used in lieu of the more formal procedure as outlined in Section 1-04.4, Changes.

The Contractor will be provided a copy of the completed order for Minor Change. The agreement for the Minor Change will be documented by signature of the Contractor, or notation of verbal agreement. If the Contractor is in disagreement with anything required by the order for Minor Change, the Contractor may protest the order as provided in Section 1-04.5.

Payments or credits will be determined in accordance with Section 1-09.4. For the purpose of providing a common Proposal for all Bidders, the Contracting Agency has entered an amount for “Minor Change” in the Proposal to become a part of the total Bid by the Contractor.

1-04.5 Procedure, Protest, and Dispute by the Contractor

If in disagreement with anything required in a change order, or the Engineer’s Written Determination or decision that the Contractor believes they are entitled to an increase in the Contract price or time, the Contractor shall:

1. Give a signed written notice of protest to the Engineer or the Engineer’s field Inspectors within 14 calendar days of receiving a change order or an Engineer’s Written Determination.
2. Supplement the written protest within 14 calendar days, or an extension of time as agreed by the Engineer in writing, with a written statement and supporting documents providing the following:
   a. The date and nature of the protested order, direction, instruction, interpretation or determination;
   b. A full discussion of the circumstances that caused the protest, including names of persons involved, time, duration and nature of the Work involved, and a review of the Plans and Contract Provisions referenced to support the protest;
   c. The estimated dollar cost, if any, of the protested Work and a detailed breakdown showing how that estimate was determined; and
   d. An analysis of the progress schedule showing the schedule change or disruption if the Contractor is asserting a schedule change or disruption.

If the Engineer determines, in writing, the supplemental information is insufficient to evaluate the protest or fails to include all required information, the Contractor may be allowed one correction of the supplemental information. The corrected supplemental information, when requested by the Engineer, shall be submitted within 14 calendar days or as specified by the Engineer, in writing.

Throughout the protested Work, the Contractor shall keep complete records of extra costs and time incurred. The Contractor shall permit the Engineer access to these and all other records related to the protested Work as determined by the Engineer.

The Engineer will evaluate all protests provided the procedures in this section are followed. If the Engineer determines that a protest has merits, the Engineer will adjust payment for Work or time by an equitable adjustment in accordance with Section 1-09.4. Extensions of time will be evaluated in accordance with Section 1-08.8. No

adjustment will be made for a protest without merit.

If the Engineer determines that the protest is without merit, that determination and the reasons for it will be provided in writing to the Contractor. The determination will be provided within 21 calendar days after receipt of the Contractor's supplemental written statement (including any additional information requested by the Engineer to support a continuing protest) described in item 2 above.

If the Contractor does not accept the Engineer's determination then the Contractor shall pursue the dispute and claims procedures set forth in Section 1-04.5(1). In spite of a protest or dispute, the Contractor shall proceed promptly with the Work as the Engineer orders.

By failing to follow the procedures of Sections 1-04.5, the Contractor completely waives any claims for protested Work.

1-04.5(1) Disputes

When protests occur during a Contract, the Contractor shall first pursue resolution through the Engineer as outlined in Section 1-04.5. Unless noted otherwise in the specifications, compliance with all the requirements of Section 1-04.5 is a Condition Precedent to initiating any action pursuant to this Section.

If the negotiations using the procedures outlined in Section 1-04.5 fail to provide satisfactory resolution of the protest, then the Contractor shall provide the Engineer with written notification of dispute stating that the Contractor will continue to pursue the dispute in accordance with the provisions of this Section. The written notification shall be provided within 14 calendar days after receipt of the Engineer's determination of merit that the Contractor's protest is without merit pursuant to Section 1-04.5.

Regardless of any protest or dispute, the Contractor shall proceed promptly with the Work as the Engineer orders and the Contracting Agency will continue to pay for all undisputed amounts.

1-04.6 Variation in Estimated Quantities

The quantity for Special Borrow including Haul has been entered into the Proposal only to provide a common proposal for bidders. Actual quantities will be determined in the field as the work progresses, and will be paid at the original bid price, regardless of final quantity. This bid item shall not be subject to the provisions of this Section.

Payment to the Contractor will be made only for the actual quantities of Work performed and accepted in conformance with the Contract. When the accepted quantity of Work performed under a unit item varies from the original Proposal quantity, payment will be at the unit Contract price for all Work unless the total accepted quantity of the Contract item, adjusted to exclude added or deleted amounts included in change orders accepted by both parties, increases or decreases by more than 25 percent from the original Proposal quantity. In that case, payment for Contract Work may be adjusted as described herein.

The adjusted final quantity shall be determined by starting with the final accepted quantity measured after all Work under an item has been completed. From this amount, subtract any quantities included in additive change orders accepted by both parties. Then, to the resulting amount, add any quantities included in deductive change orders

accepted by both parties. The final result of this calculation shall become the adjusted final quantity and the basis for comparison to the original Proposal quantity.

1. **Increased Quantities** – Either party to the Contract will be entitled to renegotiate the price for that portion of the adjusted final quantity in excess of 1.25 times the original Proposal quantity. The price for excessive increased quantities will be determined by agreement of the parties, or, where the parties cannot agree, the price will be determined by the Engineer based upon the actual costs to perform the Work, including reasonable markup for overhead and profit.
2. **Decreased Quantities** – Either party to the Contract will be entitled to an equitable adjustment if the adjusted final quantity of Work performed is less than 75 percent of the original Bid quantity. The equitable adjustment shall be based upon and limited to three factors:
   a. Any increase or decrease in unit costs of labor, materials or equipment, utilized for Work actually performed, resulting solely from the reduction in quantity;
   b. Changes in production rates or methods of performing Work actually done to the extent that the nature of the Work actually performed differs from the nature of the Work included in the original plan; and
   c. An adjustment for the anticipated contribution to unavoidable fixed cost and overhead from the units representing the difference between the adjusted final quantity and 75 percent of the original Plan quantity.

The following limitations shall apply to renegotiated prices for increases and/or equitable adjustments for decreases:

1. The equipment rates shall be actual cost but shall not exceed the rates set forth in the AGC/WSDOT Equipment Rental Agreement (referred to in Section 1-09.6) that is in effect at the time the Work is performed.
2. No payment will be made for extended or unabsorbed home office overhead and field overhead expenses to the extent that there is an unbalanced allocation of such expenses among the Contract Bid items.
3. No payment for consequential damages or loss of anticipated profits will be allowed because of any variance in quantities from those originally shown in the Proposal form, Contract Provisions, and Contract Plans.
4. The total payment (including the adjustment amount and unit prices for Work performed) for any item that experiences an equitable adjustment for decreased quantity shall not exceed 75 percent of the amount originally Bid for the item.

If the adjusted final quantity of any item does not vary from the quantity shown in the Proposal by more than 25 percent, then the Contractor and the Contracting Agency agree that all Work under that item will be performed at the original Contract unit price.

When ordered by the Engineer, the Contractor shall proceed with the Work pending determination of the cost or time adjustment for the variation in quantities.

The Contractor and the Contracting Agency agree that there will be no cost adjustment for decreases if the Contracting Agency has entered the amount for the item in the Proposal form only to provide a common Proposal for Bidders.

1-04.7 Differing Site Conditions (Changed Conditions)

During the progress of the Work, if preexisting subsurface or latent physical conditions are encountered at the site, differing materially from those indicated in the Contract, or if preexisting unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the Work provided for in the Contract, are encountered at the site, the party discovering such conditions shall promptly notify the other party in writing of the specific differing site conditions before they are disturbed and before the affected Work is performed.

Upon written notification, the Engineer will investigate the conditions to determine if conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any Work under the Contract, an adjustment, excluding loss of anticipated profits, will be made and the Contract modified in writing accordingly. The Engineer will provide the Contractor a Written Determination whether an adjustment of the Contract is warranted.

No Contract adjustment which results in a benefit to the Contractor will be allowed unless the Contractor has provided the required written notice.

The equitable adjustment will be by agreement with the Contractor. However, if the parties are unable to agree, the Engineer will determine the amount of the equitable adjustment in accordance with Section 1-09.4. Extensions of time will be evaluated in accordance with Section 1-08.8.

If the Engineer determines that different site conditions do not exist and no adjustment in costs or time is warranted, such determination shall be final as provided in Section 1-05.1.

If there is a decrease in the costs or time required to perform the Work, failure of the Contractor to notify the Engineer of the differing site conditions shall not affect the Contracting Agency's right to make an adjustment in the costs or time.

If the Contractor does not agree with the Engineer's Written Determination, the Contractor shall pursue the protest procedures in accordance with Section 1-04.5.

No claim by the Contractor shall be allowed unless the Contractor has followed the procedures provided in Sections 1-04.5 and 1-09.11.

1-04.8 Progress Estimates and Payments

Engineer-issued progress estimates or payments for any part of the Work shall not be used as evidence of performance or quantities. Progress estimates serve only as basis for partial payments. The Engineer may revise progress estimates any time before final acceptance. If the Engineer deems it proper to do so, changes may be made in progress estimates and in the final estimate.

1-04.9 Use of Buildings or Structures

The Engineer will decide whether any building or Structure on the Right of Way may remain during the Work and whether the Contractor may use such a building or Structure.

1-04.10 Use of Materials Found on the Project

With the Engineer's written approval, the Contractor may use on the project: stone,

gravel, sand, other materials from on-site excavation, or timbers removed in the course of the Work. Approval will not be granted if:

1. The excavated materials or timber fail to meet Contract requirements;
2. The excavated materials or timber are required for other use under the Contract;
3. The excavated materials are required for use as Selected Materials under Section 2-03.3(10); or
4. Such use is not in the best interests of the Contracting Agency as determined by the Engineer, whose decision shall be final as provided in Section 1-05.1.

Any material disturbed by, but not used in, the Work shall be disposed of as provided elsewhere in the Contract or as ordered by the Engineer in accordance with Section 1-04.4.

1-05 Control of Work

1-05.1 Authority of the Engineer

The Engineer shall be satisfied that all the Work is being done in accordance with the requirements of the Contract. The Contract and Specifications give the Engineer authority over the Work. Whenever it is so provided in this Contract, the decision of the Engineer shall be final: provided, however, that if a written protest is brought within the time allowed in the Contract, challenging the Engineer's Written Determination or decision, the protest addressing that Written Determination or decision shall be addressed in accordance with the procedures set forth in Section 1-04.5.

The Engineer's decisions will be final on all questions including the following:

1. Quality and acceptability of materials and Work,
2. Measurement of unit price Work,
3. Acceptability of rates of progress on the Work,
4. Interpretation of Plans and Specifications,
5. Determination as to the existence of changed or differing site conditions,
6. Fulfillment of the Contract by the Contractor,
7. Payments under the Contract including equitable adjustment,
8. Suspension(s) of Work,
9. Termination of the Contract for default or public convenience,
10. Determination as to unworkable days, and
11. Approval of Working Drawings.

The Engineer represents the Contracting Agency with full authority to enforce Contract requirements. If the Contractor fails to respond promptly to the requirements of the Contract or orders from the Engineer:

1. The Engineer may use Contracting Agency resources, other contractors, or other means to accomplish the Work; and
2. The Contracting Agency will not be obligated to pay the Contractor and will deduct from the Contractor's payments all costs that result from any other means used to carry out the Contract requirements or Engineer's orders.

At the Contractor's risk, the Engineer may suspend all or part of the Work according to Section 1-08.6.

Nothing in these Specifications or in the Contract requires the Engineer to provide the Contractor with direction or advice on how to do the Work. If the Engineer approves or recommends methods or manners for doing the Work or producing materials, the approval or recommendation shall not:

1. Guarantee that following the method or manner will result in compliance with the Contract,
2. Relieve the Contractor of any risks or obligations under the Contract, or
3. Create a Contracting Agency liability.

1-05.1(1) Oral Orders

When an oral order, including directions, instructions, interpretations, and determinations are issued by the Engineer, the Contracting Agency will send a Written Determination to the Contractor within 3 calendar days thereafter. If the Engineer determines that a change to the Contract is warranted, a written change order will be processed in accordance with Section 1-04.4. If the Contractor disagrees with the Written Determination, the Contractor may protest in accordance with Section 1-04.5.

When the Contractor believes they have received an oral order, the Contractor shall notify the Engineer in writing and within 3 calendar days. After the Contractor notifies the Engineer, the Contracting Agency will respond with a Written Determination within 14 calendar days. If the Engineer determines that a change to the Contract is warranted, a written change order will be processed in accordance with Section 1-04.4. If the Contractor disagrees with the Written Determination, the Contractor may protest in accordance with Section 1-04.5. Failure to follow procedures of this section will result in a waiver of claim.

1-05.1(2) Requests for Information (RFI)

No Claim shall be allowed because of ambiguities in the Contract if:

1. The Contractor discovers an ambiguity but fails to notify the Contracting Agency, or
2. The Contractor failed to discover a patent ambiguity that would be discovered by a reasonably prudent Contractor.

If the Contractor discovers an ambiguity in the Contract or desires an explanation or interpretation of the Contract, they shall request the explanation or interpretation in writing by way of a Request for Information (RFI). The RFI shall clearly define the ambiguity and have enough detail for the Engineer to provide an explanation or interpretation. If such detail is not provided, the Engineer will return the RFI as incomplete. Should the RFI require a change to the Contract, the Contractor will indicate in their RFI that it includes a request for change (RFC).

A RFI shall not be used nor constitute a notice required in accordance with Sections 1-04.5 and 1-04.7.

The Contractor may submit a RFI for the one of following reasons:

1. The Contractor believes there is information missing from the Contract Documents (Missing Information).

2. The Contractor believes a clarification of one or more of the Contract requirements is necessary (Clarification).
3. The Contractor needs to repair or otherwise correct a deficiency in the Work that requires a Change to the Contract to be acceptable (RFC – Construction Deficiency/Repair procedure). Requests submitted for this reason shall be submitted in accordance with Section 1-05.7(1).
4. The Contractor needs to substitute a material that provides an equal or better level of performance as the one specified in the Contract (RFC – Material Substitution). Requests shall indicate the location(s), quantity, and shall describe how the material provides an equal or better level of performance as the material originally specified.
5. The Contractor may submit a RFI that requests a change to the Contract requirements for a reason other than one listed in items 1-4 of this section (RFC – Other). To be considered, the request must not meet the requirements of a Value Engineering Change Proposal. To be considered, the request shall qualify as a Minor Change in accordance with Section 1-04.4(1) and shall describe how the change is and shall describe how the change is beneficial to the project.

The Engineer will respond, in writing, to RFIs within 14 calendar days in the order they are received. If the Engineer cannot respond within 14 calendar days due to the nature and complexity of the RFI, the Engineer will respond to the RFI stating how many additional days are needed for a full response. This does not relieve the Contractor of its responsibility to request a time extension in accordance with Section 1-08.8. If the Contractor needs to prioritize a RFI it shall indicate so as part of the RFI. Oral explanations, interpretations, or instructions given by anyone other than the Engineer will not be binding on the Contracting Agency. A response to a RFI shall be considered a Written Determination.

If the Contractor's Request for Information requires a change order, the Engineer's response will indicate whether they are authorizing the Contractor to proceed with the changed work prior to an executed change order. Without this authorization, the Contractor shall not proceed with the changed work until a Change Order has been processed. If the Contractor believes the response requires a change order and the Engineer does not specifically state that a change order is necessary, the Contractor shall submit their Protest in accordance with Section 1-04.5. Proceeding without Protest shall waive the Contractor's rights to Claim.

The Contractor shall bear all risk and costs of Work delays caused by rejection or nonapproval of RFIs that Requests for Change (RFC). The Contractor agrees the Engineer is under no obligation to accept an RFC. The Engineer's decision to accept or reject all or part of a RFI that requests a change is final and not subject to Protest.

Unit Bid prices shall cover all costs of submitting RFIs.

1-05.2 Authority of Assistants and Inspectors

Assistants and Inspectors have the authority to determine if the Work and materials meet the Contract requirements, reject defective material and suspend Work that is being done improperly, subject to the final decisions of the Engineer.

Assistants and Inspectors are not authorized to accept Work, to accept materials, to

issue instructions, or to give advice that is contrary to the Contract. Work done or material furnished that does not meet the Contract requirements shall be at the Contractor's risk and shall not be a basis for a claim even if the Inspectors or assistants purport to change the Contract.

Assistants and Inspectors may advise the Contractor of faulty Work or materials or infringements of the terms of the Contract; however, failure of the Engineer or the assistants or Inspectors to advise the Contractor does not constitute acceptance or approval.

1-05.3 Working Drawings

The Contract may require the Contractor to submit Working Drawings for the performance of the work. Working Drawings shall be submitted by the Contractor electronically to the Engineer in PDF format; drawing details shall be prepared in accordance with conventional detailing practices. Unless allowed by the Engineer, the default page size shall be 8½ by 11 inches for text and calculations and 11 by 17 inches for drawings.

Working Drawings will be classified under the following categories:

1. **Type 1** – Submitted for Contracting Agency information. Submittal must be received by the Contracting Agency a minimum of 7 calendar days before Work represented by the submittal begins.
2. **Type 2** – Submitted for Contracting Agency review and comment. Unless otherwise stated in the Contract, the Engineer will require up to 20 calendar days from the date the Working Drawing is received until it is returned to the Contractor. The Contractor shall not proceed with the Work represented by the Working Drawing until comments from the Engineer have been addressed.
3. **Type 2E** – Same as a Type 2 Working Drawing with Engineering as described below.
4. **Type 3** – Submitted for Contracting Agency review and approval. Unless otherwise stated in the Contract, the Engineer will require up to 30 calendar days from the date the Working Drawing is received until it is returned to the Contractor. The Contractor shall obtain the Engineer's written approval before proceeding with the Work represented by the Working Drawing.
5. **Type 3E** – Same as a Type 3 Working Drawing with Engineering as described below.

All Working Drawings shall be considered Type 3 Working Drawings except as specifically noted otherwise in the Contract. Unless designated otherwise by the Contractor, submittals of Working Drawings will be reviewed in the order they are received by the Engineer. In the event that several Working Drawings are received simultaneously, the Contractor shall specify the sequence in which they are to be reviewed. If the Contractor does not submit a review sequence for simultaneous Working Drawing submittals, the review sequence will be at the Engineer's discretion.

Working Drawings requiring Engineering, Type 2E and 3E, shall be prepared by (or under the direction of) a Professional Engineer, licensed under Title 18 RCW, State of Washington, and in accordance with WAC 196-23-020. Design calculations shall carry the Professional Engineer's signature and seal, date of signature, and registration number on the cover page. The cover page shall also include the Contract number,

Contract title and sequential index to calculation page numbers.

If more than the specified number of calendar days is required for the Engineer's review of an individual Working Drawing or resubmittal, an extension of time will be considered in accordance with Section 1-08.8.

Review or approval of Working Drawings shall neither confer upon the Contracting Agency nor relieve the Contractor of any responsibility for the accuracy of the drawings or their conformity with the Contract. The Contractor shall bear all risk and all costs of any Work delays caused by rejection or nonapproval of Working Drawings.

Unit Bid prices shall cover all costs of Working Drawings.

1-05.4 Conformity with and Deviations from Plans and Stakes

The Contractor shall be responsible for the project surveying. The Contractor shall take full responsibility for detailed dimensions, elevations, and slopes measured from them.

All Work performed shall be in conformity with the lines, grades, slopes, cross-sections, superelevation data, and dimensions as shown in the Plans, or as staked. If the Plans, Special Provisions, or these Specifications, state specific tolerances, then the Work shall be performed within those limits. The Engineer's decision on whether the Work is in conformity shall be final, as provided in Section 1-05.1.

The Contractor shall not deviate from the approved Plans and Working Drawings unless the Engineer approves in writing.

The Contracting Agency has provided primary survey control in the Plans.

The Contractor shall be responsible for setting, maintaining, and resetting all alignment stakes, slope stakes, and grades necessary for the construction of foundations, drainage, water main, other buried utilities, surfacing, paving, channelization and pavement marking, illumination and signals, fencing, signing, building foundations, waterline, other buried utilities, etc. Except for the survey control data to be furnished by the Contracting Agency, calculations, surveying, and measuring required for setting and maintaining the necessary lines and grades shall be the Contractor's responsibility.

The Contractor shall inform the Engineer when monuments are discovered that were not identified in the Plans and construction activity may disturb or damage the monuments. All monuments noted on the plans "DO NOT DISTURB" shall be protected throughout the length of the project or be replaced at the Contractors expense.

Detailed survey records shall be maintained, including a description of the work performed on each shift, the methods utilized, and the control points used. The record shall be adequate to allow the survey to be reproduced. A copy of each day's record shall be provided to the Engineer within three working days after the end of the shift.

The meaning of words and terms used in this provision shall be as listed in "Definitions of Surveying and Associated Terms" current edition, published by the American Congress on Surveying and Mapping and the American Society of Civil Engineers.

The survey work shall include but not be limited to the following:

1. Verify the primary horizontal and vertical control furnished by the Contracting Agency, and expand into secondary control by adding stakes and hubs as well as additional survey control needed for the project. Provide descriptions of secondary control to the Contracting Agency. The description shall include coordinates and elevations of all secondary control points.
2. Establish the centerlines of all alignments, by placing hubs, stakes, or marks on centerline or on offsets to centerline at all curve points (PCs, PTs, and PIs) and at points on the alignments spaced no further than 50 feet.
3. Establish clearing limits, placing stakes at all angle points and at intermediate points not more than 50 feet apart. The clearing and grubbing limits shall be 5 feet beyond the toe of a fill and 10 feet beyond the top of a cut unless otherwise shown in the Plans.
4. Establish grading limits, placing slope stakes at centerline increments not more than 50 feet apart. Establish offset reference to all slope stakes. If Global Positioning Satellite (GPS) Machine Controls are used to provide grade control, then slope stakes may be omitted at the discretion of the Contractor
5. Establish the horizontal and vertical location of all drainage features, placing offset stakes to all drainage structures and to pipes at a horizontal interval not greater than 25 feet.
6. Establish subgrade and surfacing elevations for pavements by placing stakes at the top of subgrade and at the top of each course of surfacing. Subgrade and surfacing stakes shall be set at horizontal intervals not greater than 50 feet in tangent sections, 25 feet in curve sections with a radius less than 300 feet, and at 10-foot intervals in intersection radii with a radius less than 10 feet. Transversely, stakes shall be placed at all locations where the slope changes and at additional points such that the transverse spacing of stakes is not more than 12 feet. If GPS Machine Controls are used to provide grade control, then roadbed and surfacing stakes may be omitted at the discretion of the Contractor.
7. Establish intermediate elevation benchmarks as needed to check work throughout the project.
8. Provide references for paving pins at 25-foot intervals or provide simultaneous surveying to establish location and elevation of paving pins as they are being placed.
9. For all other types of construction included in this provision, (including but not limited foundations, all utilities, pavement marking, illumination and signals, fencing, and signing) provide staking and layout as necessary to adequately locate, construct, and check the specific construction activity.
10. Contractor shall determine if changes are needed to the profiles or roadway sections shown in the Contract Plans in order to achieve proper smoothness and drainage where matching into existing features, such as a smooth transition from new pavement to existing pavement. The Contractor

shall submit these changes to the Engineer for review and approval 10 days prior to the beginning of work.

The Contractor shall provide the Contracting Agency copies of any calculations and staking data when requested by the Engineer.

The Contractor shall ensure a surveying accuracy within the following tolerances:

	Vertical	Horizontal
Slope stakes	±0.10 feet	±0.10 feet
Subgrade grade stakes set		
0.04 feet below grade	±0.01 feet	±0.5 feet (parallel to alignment) ±0.1 feet (normal to alignment)
Alignment	N/A	±0.04 feet
Surfacing grade stakes	±0.01 feet	±0.5 feet (parallel to alignment) ±0.1 feet (normal to alignment)
Paving pins for		
surfacing or paving	±0.01 feet	±0.2 feet (parallel to alignment) ±0.1 feet (normal to alignment)

The Contracting Agency may spot-check the Contractor's surveying. These spot-checks will not change the requirements for normal checking by the Contractor.

When staking roadway alignment and stationing, the Contractor shall perform independent checks from different secondary control to ensure that the points staked are within the specified survey accuracy tolerances.

The Contractor shall calculate coordinates for the alignment. The Contracting Agency will verify these coordinates prior to issuing approval to the Contractor for commencing with the work. The Contracting Agency will require up to seven calendar days from the date the data is received.

Contract work to be performed using contractor-provided stakes shall not begin until the stakes are approved by the Contracting Agency. Such approval shall not relieve the Contractor of responsibility for the accuracy of the stakes.

Stakes shall be marked in accordance with Standard Plan A10.10. When stakes are needed that are not described in the Plans, then those stakes shall be marked, at no additional cost to the Contracting Agency as ordered by the Engineer.

Payment

Payment will be made for the following bid item:

"Surveying", lump sum.

The lump sum contract price for "Surveying" shall be full pay for all labor, equipment, materials, and supervision utilized to perform the Work specified, including any resurveying, checking, correction of errors, replacement of missing or damaged stakes, and coordination efforts.

1-05.5 Tolerances

Geometrical tolerances shall be measured from the points, lines, and surfaces defined in Contract documents.

A plus (+) tolerance increases the amount or dimension to which it applies, or raises a deviation from level. A minus (-) tolerance decreases the amount or dimension to which it applies, or lowers a deviation from level. Where only one signed tolerance is specified (+ or -), there is no specified tolerance in the opposing direction.

Tolerances shall not be cumulative. The most restrictive tolerance shall control.

Tolerances shall not extend the Work beyond the Right of Way or other legal boundaries identified in the Contract documents. If application of tolerances causes the extension of the Work beyond the Right of Way or legal boundaries, the tolerance shall be reduced for that specific instance.

Tolerances shall not violate other Contract requirements. If application of tolerances causes the Work to violate other Contract requirements, the tolerance shall be reduced for that specific instance. If application of tolerances causes conflicts with other components or aspects of the Work, the tolerance shall be reduced for that specific instance.

1-05.6 Inspection of Work and Materials

The Engineer may inspect all Work and materials for conformity with Contract terms. To ensure the Engineer’s safety and access during these inspections, the Contractor shall provide any equipment needed, such as walkways, railings, ladders, and platforms.

When the Engineer requests, the Contractor shall (without charge) provide samples of materials used or to be used in the Work. If the Contractor uses materials tested and approved for one project in an unrelated project, the Contracting Agency may deduct its testing and inspection costs from payments due the Contractor. The Engineer may order the Contractor to remove and replace materials used without inspection and the Contractor shall bear the cost of doing so.

Inspections, tests, measurements, or other actions by Contracting Agency employees serve only one purpose: to assure the Engineer that Work, materials, progress rate, and quantities comply with Contract terms. Such work by Contracting Agency employees shall not relieve the Contractor of its responsibility for completing the Work or for determining if Contract requirements are being met. The Contractor shall correct all substandard Work or materials. The Engineer will reject unsuitable Work or materials even though inspected or paid for in a progress estimate.

If the Engineer requests, then the Contractor shall remove or uncover any requested

area of the completed Work. After the Engineer inspects it, the Contractor shall restore the area to the standard the Contract requires. The Contractor shall bear the cost of uncovering, removing, and restoring the exposed Work: (a) if it proves unacceptable, or (b) if it was placed without authority or without due notice to the Engineer. The Contracting Agency will pay these costs by agreed price or by force account if the Work proves to be acceptable and the Contractor had performed the original Work with the authority of and due notice to the Engineer.

The Contractor, if advised to do so by the Engineer, shall permit inspection of the Work from a representative of Railroad Companies, utilities, facilities of a public agency, or federal, state, or municipal agencies.

For crushing or screening operations, the Contractor shall provide and install a mechanical sampler that:

1. Is automatic or semi-automatic;
2. Can safely and easily obtain representative samples of the materials being produced;
3. Can convey the samples to ground level in Contracting Agency-provided sacks;
4. Moves at an even rate through the full width of the materials stream falling from the discharge end of the belt, gate, or chute;
5. Is power driven during the material intercept cycle; and
6. Can be adjusted to take samples of about 100 pounds as often as the Engineer requires.

No material from the crushing or screen operation will be accepted until after the Engineer has approved the design and operation of the sampling equipment. The Contractor shall bear all costs of providing the sampling equipment, the power to operate it, and the space for its use.

1-05.7 Removal of Defective and Unauthorized Work

The Contracting Agency will not pay for unauthorized or defective Work. Unauthorized or defective Work includes: Work and materials that do not conform to Contract requirements; Work done beyond the lines and grades set by the Plans or the Engineer; and extra Work and materials furnished without the Engineer's written approval. The Contractor shall be responsible to immediately report to the Engineer all unauthorized or defective Work. The Contractor shall immediately remedy, remove, replace, or dispose of unauthorized or defective Work or materials and bear all costs of doing so.

If the Contractor fails to remedy defective or unauthorized work within the time specified in a written notice from the Engineer or fails to perform any part of the work required by the Contract Documents, the Engineer may correct and remedy such work as may be identified in the written notice, with Contracting Agency forces or by such other means as the Contracting Agency may deem necessary.

If the Contractor fails to comply with a written order to remedy what the Engineer determines to be an emergency situation, the Engineer may have the defective and unauthorized work corrected immediately, have the rejected work removed and replaced, or have work the Contractor refuses to perform completed by using Contracting Agency or other forces. An emergency situation is any situation when, in the opinion of the

Engineer, a delay in its remedy could be potentially unsafe, or might cause serious risk of loss or damage to the public.

Direct or indirect costs incurred by the Contracting Agency attributable to correcting and remedying defective or unauthorized work, or work the Contractor failed or refused to perform, shall be paid by the Contractor. Payment will be deducted by the Engineer from monies due, or to become due, the Contractor. Such direct and indirect costs shall include in particular, but without limitation, compensation for additional professional services required, and costs for repair and replacement of work of others destroyed or damaged by correction, removal, or replacement of the Contractor's unauthorized work.

No adjustment in contract time or compensation will be allowed because of the delay in the performance of the work attributable to the exercise of the Contracting Agency's rights provided by this Section.

The rights exercised under the provisions of this section shall not diminish the Contracting Agency's right to pursue any other avenue for additional remedy or damages with respect to the Contractor's failure to perform the work as required.

1-05.7(1) Request for Change for Defective or Unauthorized Work

The Contractor may, as a request for information (RFI) in accordance with Section 1-05.1(2), submit a request to repair, replace or substitute defective, rejected, non-conforming, or unacceptable Work (RFC-Construction Deficiency/Repair Procedure).

RFIs submitted for RFC-Construction Deficiency/Repair Procedure shall include Type 2 Working Drawings. Type 2E Working Drawings shall be submitted when required by the Engineer. For preapproved repair procedures, Type 1 Working drawings shall be included. All requirements within the Contract for the repair, replacement or substitution of defective, rejected, non- conforming or unacceptable Work shall be followed and submitted as part of a RFI for RFC-Construction Deficiency/Repair Procedure. The Engineer has the right to reject all or part of the defective Work, and the Engineer's decision is final and not subject to protest.

1-05.8 Vacant

1-05.9 Equipment

Prior to mobilizing equipment on site, the Contractor shall thoroughly remove all loose dirt and vegetative debris from drive mechanisms, wheels, tires, tracks, buckets and undercarriage. The Engineer will reject equipment from the site until it returns clean.

At the Engineer's request, the Contractor shall provide an operating and maintenance manual for each model or type of mixing, placing, or processing equipment before using it in the Work. The Contractor shall also provide test instruments to confirm whether the equipment meets operating requirements, such as vibration rate, revolutions-per-minute, or other requirements.

The Contract may require automatically controlled equipment for some operations. If the automatic controls on such equipment fail, then the Contractor may operate the equipment manually for the remainder of that normal working day, provided the method of operation produces results otherwise meeting the Specifications. Continued operation of the equipment manually beyond this working day will be permitted only by specific

authorization of the Engineer.

The Engineer will reject equipment that repeatedly breaks down or fails to produce results within the required tolerances. The Contractor shall have no claim for additional payment or for extension of time due to rejection and replacement of equipment.

Upon completion of the Work, the Contractor shall completely remove all loose dirt and vegetative debris from equipment before removing it from the job site.

1-05.10 Guarantees

The Contractor shall furnish to the Contracting Agency all guarantees or warranties furnished as a customary trade practice in connection with the purchase of equipment, materials, or items incorporated into the project as follows:

1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

1-05.11 Final Inspection and Commissioning

1-05.11(1) Substantial Completion Date

When the Contractor considers the work to be substantially complete, the Contractor shall so notify the Engineer and request the Engineer establish the Substantial Completion Date. The Contractor’s request shall list the specific items of work that remain to be completed in order to reach physical completion. The Engineer will schedule an inspection of the work with the Contractor to determine the status of completion. The Engineer may also establish the Substantial Completion Date unilaterally.

If, after this inspection, the Engineer concurs with the Contractor that the work is substantially complete and ready for its intended use, the Engineer, by written notice to the Contractor, will set the Substantial Completion Date. If, after this inspection the Engineer does not consider the work substantially complete and ready for its intended use, the Engineer will, by written notice, so notify the Contractor giving the reasons therefor.

Upon receipt of written notice concurring in or denying substantial completion, whichever is applicable, the Contractor shall pursue vigorously, diligently and without unauthorized interruption, the work necessary to reach Substantial and Physical Completion. The Contractor shall provide the Engineer with a revised schedule indicating when the Contractor expects to reach substantial and physical completion of the work.

The above process shall be repeated until the Engineer establishes the Substantial Completion Date and the Contractor considers the work physically complete and ready for final inspection.

1-05.11(2) Final Cleaning

Prior to final inspection, the Contractor shall perform a final cleaning in accordance with the following:

1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.
2. Use cleaning materials that are nonhazardous.
3. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
4. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
5. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
6. Replace filters of operating equipment.
7. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
8. Clean site; sweep paved areas, rake clean landscaped surfaces.
9. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

1-05.11(3) Final Inspection and Physical Completion Date

When the Contractor considers the work physically complete and ready for final inspection, the Contractor by written notice, shall request the Engineer to schedule a final inspection. The Engineer will set a date for final inspection. The Engineer and the Contractor will then make a final inspection and the Engineer will notify the Contractor in writing of all particulars in which the final inspection reveals the work incomplete or unacceptable. The Contractor shall immediately take such corrective measures as are necessary to remedy the listed deficiencies. Corrective work shall be pursued vigorously, diligently, and without interruption until physical completion of the listed deficiencies. This process will continue until the Engineer is satisfied the listed deficiencies have been corrected.

> If action to correct the listed deficiencies is not initiated within 7 days after receipt of the written notice listing the deficiencies, the Engineer may, upon written notice to the Contractor, take whatever steps are necessary to correct those deficiencies pursuant to Section 1-05.7.

The Contractor will not be allowed an extension of contract time because of a delay in the performance of the work attributable to the exercise of the Engineer’s right hereunder.

Upon correction of all deficiencies, the Engineer will notify the Contractor and the Contracting Agency, in writing, of the date upon which the work was considered physically complete. That date shall constitute the Physical Completion Date of the contract but

shall not imply acceptance of the work or that all the obligations of the Contractor under the contract have been fulfilled.

1-05.11(4) Commissioning

SUMMARY

Section Includes:

1. General requirements for coordinating and scheduling commissioning.
2. Commissioning meetings
3. Commissioning reports
4. Use of test equipment, instrumentation, and tools for commissioning.
5. Construction checklists, including, but not limited to, installation checks, startup, and performance tests.
6. Commissioning tests
7. Adjusting, verifying, and documenting identified systems and assemblies.

Work included under this section includes a complete and thorough investigation of equipment and systems indicated in Part 3 of section. In order to ensure proper installation and operation of components and systems. Contractor shall perform commissioning as described herein to accomplish the tasks, and goals of commissioning. Systems to be evaluated include but are not limited to:

1. Openings Coordinate list with list produced by the Commissioning Authority.
2. Equipment
3. Fire Suppression
4. Plumbing
5. HVAC (Heating, Ventilation, and Air Conditioning)
6. Electrical Communications
7. Communications
8. Electronic Safety and Security
9. Motorized Cantilever Slide Gates and Automatic Barrier Gates.
10. Lubrication Delivery Systems
11. Bridge Crane Equipment

Building commissioning activities and documentation are described in the following reference material: United States Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED™) rating program, American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Guideline 0-2005, The Commissioning Process, and National Institute of Building Sciences (NIBS) Guidelines.

DEFINITIONS

1. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity.
2. Contractor's Commissioning Representative: (CCxR) Contractor's designated individual to coordinate, manage, and execute commissioning processes of the contracting organizations.
3. Commissioning Plan (CCxP): Plan that provides structure, schedule and coordination planning for commissioning process proposed specifically for this project. CCxP includes Personnel, activities, and a description of Infrastructure, and list of instruments and logging devices that will be used during Commissioning.
4. Deficiency: Condition in the installation or function of a component, piece of equipment or system not in compliance with Contract Documents, does not perform properly or is not complying with Basis of Design.
5. Functional Performance Test (FPT): Test of dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional performance testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The CCxR develops the sequentially written functional test procedure forms, and oversees and documents the actual testing, which is performed by the installing contractor or vendor. The CCxR creates worksheets from these forms which include procedures required to accommodate actual equipment, means and methods used in the project. Functional Performance Tests are performed after pre-functional checklists and startup is complete.
6. Manual Test: Using hand-held instruments, control system readouts or direct observation to verify performance (contrasted to analyzing electronically monitored data taken over time to make the "observation").
7. Monitoring: Recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.
8. Pre-functional Checklist: List of items to inspect and elementary component tests to conduct to verify proper installation of equipment. Pre-functional checklists are primarily static inspections and procedures to prepare equipment or system for initial operation (e.g., belt tension, oil levels ok, labels affixed, gages in place,

sensors calibrated, etc.). However, some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring voltage imbalance on a three-phase pump motor of a chiller system). Pre-functional" refers to "before" functional testing. Pre-functional checklists augment and are combined with the equipment manufacturer's start-up checklist.

9. Systems Manual: System focused composite document that includes operational manual, maintenance manual, and additional information of use to Government during Occupancy and Operation Phase.

COMMISSIONING TEAM

Members Appointed by Contractor(s): Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action.

1. CCxR (Contractor's Commissioning Representative): CCxR shall be approved by Contracting Officer and satisfy as many of the following requirements as possible:
    a. Certified in Commissioning by nationally accredited organization (i.e. Associated Air Balance Council (AABC), Association of Energy Engineers (AEE), Building Commissioning Association (BCA), and National Environmental Balancing Bureau (NEBB))
    b. Acted as principal Commissioning Authority where total building commissioning approach (including building envelope) was used for at least three projects of comparable size, type, and scope.
    c. Technical training in Mechanical, Electrical, and/or fire protection engineering.
    d. Past commissioning experience.
    e. Knowledge of national codes.
    f. Experience in energy-efficient design and control strategy optimization.
    g. Specific experience with specialty systems relative to particular facility type (i.e. security systems, etc.).
2. Contractor Quality Control (CQC) Supervisor
3. Other Representatives may include Project superintendents, installers, suppliers, and specialists.

Members Appointed by Contracting Agency:

1. Representatives of facility user and operation and maintenance personnel.
2. Engineering design professionals.

CONTRACTOR'S RESPONSIBILITIES

Contractor shall assign representatives with expertise and authority to act on its behalf to participate in and perform commissioning process activities including:

1. Perform commissioning tests, as required by technical specifications. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
2. Record and resolve commissioning issues.
3. Integrate and coordinate commissioning process activities with overall project schedule.
4. Complete commissioning process test procedures.
5. Provide maintenance orientation and inspection for systems, assemblies, equipment, and components based on contract requirements.
6. Provide Commissioning Plan and documentation for final commissioning documentation.
7. Provide measuring instruments and logging devices to record test data and provide data acquisition equipment to record data for complete range of testing for required test period.

COMMISSIONING DOCUMENTATION

Provide the following information:

1. Review of systems manual, submittals, documents, and other commissioning reports
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase
3. Commissioning Plan including Process activities and schedule for completing construction checklists and manufacturer's pre-start and startup checklists for systems, assemblies, equipment, and components to be verified and tested
4. Certificate of readiness certifying systems, subsystems, equipment, and associated controls are ready for testing
5. Test and inspection reports and certificates
6. Corrective action documents
7. Testing, adjusting, and balancing reports

SUBMITTALS

1. Certificates of readiness.
2. Contractor’s Commissioning Representative Qualifications.
3. Commissioning Plan: Submit within 30 calendar days of authorization to proceed.

a. Update as necessary during the work to reflect progress on components and systems.

4. Pre functional checklists.
5. Functional performance test forms: Submit minimum 30 calendar days prior to testing
6. Deficiency Report and Resolution Record: Document items of non-compliance in materials, installation or operation. Document results from start-up/pre-functional checklists, functional performance testing, and short-term diagnostic monitoring. Include details of components or systems found to be non-compliant with drawings and specifications. Identify adjustments and alterations required to correct system operation and identify who is responsible for making corrective changes.
    a. Update as necessary during work to reflect progress on components and systems. Submit updated versions monthly.
7. Closeout Documentation
    a. Closeout documents for commissioned equipment and systems shall be submitted prior to functional performance testing. These include:
        1) Record Documents and Drawings
        2) Start-up certificates for commissioned equipment with start-up requirements
        3) Systems Manual
        4) Include TAB, startup, and Control System check-out reports.
        5) Other documents required by other sections as applicable.
    b. Operation and Maintenance (O&M) Submittals (refer to requirements of technical specifications):
        1) Training plan: Include for each training session:
            a) Dates, start and finish times, and locations
            b) Outline of the information to be presented
            c) Names and qualifications of presenters
            d) List of texts and materials required to support training

PRODUCTS

TEST EQUIPMENT

Instrumentation shall:

1. Be of sufficient quality and accuracy to test and measure system performance within tolerances required to determine adequate performance. If not otherwise noted, the following minimum requirements apply:

a. Temperature sensors and digital thermometers have a certified calibration to NIST traceable standards within the past year to an accuracy of 0.5 degrees F and a resolution of ±0.1 degrees F.

b. Pressure Sensors: Accuracy of ±2.0 percent of the value range being measured (not full range of meter) and have been calibrated within the last year.

c. Water Flow Meters: Accuracy of ±2.0 percent of the value range being measured (not full range of meter) and have been calibrated within the last year.

d. Airflow Meters: Accuracy of ±3.0 percent of the value range being measured (not full range of meter) and have been calibrated within the last year.

e. Dew Point Sensors: Certified calibration within the past year to an accuracy of ±1 degrees F dp and a resolution of ±0.1 degrees F dp.

f. Relative Humidity Sensors: Certified calibration within the past year to an accuracy of ±2 percent RH and a resolution of ±1 percent RH.

g. CO2 Sensors: Certified calibration within the past year to an accuracy of ±50 ppm and a resolution of ±1 ppm.

h. VOC Sensors: Certified calibration within the past year to an accuracy of ±50 ppm and a resolution of ±1 ppm.

i. CO Sensors: Certified calibration within the past year to an accuracy of ±50 ppm and a resolution of ±1 ppm.

2. Be calibrated on manufacturer's recommended intervals calibration tags permanently affixed to instrument being used.

3. Be maintained in good repair and operation condition throughout duration of use on this project.

Standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by Contractor for equipment being tested.

Required commissioning equipment (sensors, transducers, data loggers, etc.) not integral to the systems or equipment installed shall be provided by Contractors Commissioning Representative and shall not become property of the Government.

PRE-FUNCTIONAL CHECKLIST:

1. Prepare pre functional checklists for equipment and systems to be commissioned.

2. Pre-functional checklists shall be part of the Commissioning Plan .

FUNCTIONAL TEST PROCEDURE FORMS:

1. Prepare functional test procedure forms for each piece of equipment and each system to be commissioned.

FUNCTIONAL PERFORMANCE WORKSHEETS:

1. Prepare Functional Performance worksheets, consisting of test procedures and expected results of testing.

REPORT FORMAT AND ORGANIZATION

General Format and Organization:

1. Bind report in three-ring binders.
2. Label front cover and spine of each binder with report title, volume number, project name, Contractor's name, and date of report.
3. Record report in electronic format on a thumb drive.
4. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

Commissioning Report:

1. Include table of contents and an index to each test.
2. Include major tabs for each Specification Section.
3. Include minor tabs for each test.
4. Within each minor tab, include:
    a. Test specification.
    b. Pre-startup reports.
    c. Approved test procedures.
    d. Test data forms, completed and signed.
    e. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within minor tab, in reverse chronological order (most recent on top).

EXECUTION

COMMISSIONING PROCESS

Following activities outline general commissioning tasks (requiring development, execution, etc.) and order in which they occur.

1. Commissioning Scoping Meeting
2. Commissioning Plan
3. Prepare pre-functional checklists.
4. Prepare functional performance worksheets.
5. Perform Start-Up/Pre-Functional Checks in accordance with manufacturer's recommendations and pre-functional checklists.
6. Functional Performance Testing in accordance with functional performance worksheets
7. Deficiency Report and Resolution Record
8. Operation and Maintenance Documentation
9. Operations and Maintenance Training
10. Deferred Testing (?)

TOTAL BUILDING COMMISSIONING (TBC) REQUIREMENTS

TBC during construction, acceptance, and warranty phases is intended to achieve following specific objectives:

1. Verify equipment is what was submitted and approved.
2. Verify and document equipment is installed and started per manufacturer's recommendations, industry accepted minimum standards, and Contract Documents.
3. Verify and document equipment and systems receive complete operational checkout by installing contractors.
4. Verify and document equipment capacity and system efficiency.
5. Verify performance of building envelope. Document testing and conformance to Contract Documents.
6. Verify completeness of operations and maintenance materials.
7. Ensure Contracting Agency operating personnel are adequately trained on operation and maintenance of building equipment.

COMMISSIONING SCOPING MEETING

Commissioning Scoping Meeting:

1. Schedule, coordinate, and facilitate a scoping meeting.
2. Review each building system to be commissioned, including intended operation, commissioning requirements, and completion and start-up schedules.
3. Establish scope of work, tasks, schedules, deliverables, and responsibilities for implementation of Commissioning Plan.
4. Attendance: Commissioning Team members.

COMMISSIONING PLAN

Commissioning Plan: Develop commissioning plan to identify how commissioning activities will be integrated into general construction and trade activities. Commissioning plan shall identify how commissioning responsibilities are distributed. Intent of plan is to evoke questions, expose issues, and resolve issues with input from entire commissioning team early in construction.

1. Identify who will be responsible for producing various procedures, reports, Contracting Officer notifications and forms.
2. Include commissioning tasks and activities in overall project schedule. Tag individual activities so they can be filtered at later date.
3. List and describe each test/acceptance procedure, including acceptance criteria.

START-UP/PRE-FUNCTIONAL CHECKLISTS

Start-Up/Pre-Functional Checklists: Complete pre-functional checklists prior to start up as included at the end of this section Checklist shall help verify that systems are complete and operational, so functional performance testing can be scheduled.

1. Verify equipment installed is what was approved on Submittal.
2. Manufacturer’s start-up checklists and other technical documentation guidelines may be used as basis for pre-functional checklists.

FUNCTIONAL PERFORMANCE TESTING

Functional Performance Testing: Test procedures fully describe system configuration and steps required for each test.

1. Test Methods: Functional performance testing and verification may be achieved by direct manipulation of system inputs (i.e. heating or cooling sensors), manipulation of system inputs with building automation system (i.e. software override of sensor inputs), trend logs of system inputs and outputs using building automation system, or short-term monitoring of system inputs and outputs using standalone data loggers. A combination of methods may be required to completely test complete sequence of operations. CCxR shall determine which method or combination of methods is most appropriate.
2. Setup: Each test procedure shall be performed under conditions that simulate normal operating conditions as closely as possible. Where equipment requires

integral safety devices to stop/prevent equipment operation unless minimum safety standards or conditions are met, functional performance test procedures shall demonstrate actual performance of safety shutoffs in real or closely simulated conditions of failure.

3. Sampling: Multiple identical pieces of non-life-safety or non-critical equipment may be functionally tested using a sampling strategy. If, after three attempts at testing the specified sample percentage, failures are still present, remaining units shall be tested at Contractors' expense.

Prepare functional performance test procedure forms to accommodate actual installed equipment and systems as included at the end of this section.

Coordinate, execute, and record results of functional performance testing using .

1. Coordinate retesting as necessary until satisfactory performance is verified.
2. Verify intended operation of individual components and system interactions under various conditions and modes of operation.

DEFICIENCY REPORT AND RESOLUTION RECORD

Deficiency Report and Resolution Record: Document items of non-compliance in materials, installation or operation.

Non-Conformance. Non-conformance and deficiencies observed shall be addressed immediately. Notify responsible parties and provide recommended actions to correct deficiencies.

1. Corrections of minor deficiencies identified may be made during tests at discretion of CCxR. In such cases the deficiency and resolution shall be documented on procedure form.
2. For identified deficiencies:
    a. If no dispute on deficiency and responsibility to correct it:
        1) CCxR documents deficiency and adjustments or alterations required to correct it. Contractor corrects deficiency and notifies CCxR that equipment is ready to be retested.
        2) CCxR reschedules test and test is repeated until satisfactory performance is achieved.
    b. If there is a dispute about a deficiency or who is responsible:
        1) Deficiency is documented CCxR on non-compliance form.
        2) Resolutions are made at lowest management level possible. Additional parties are brought into discussions as needed. Contractor shall have responsibility for resolving construction deficiencies. If a design revision is deemed necessary and approved by Contracting Officer, Architect/Engineer (A/E) shall have responsibility for providing design revision. CCxR documents resolution process.

3) Once interpretation and resolution have been decided, appropriate party corrects deficiency and notifies CCxR that equipment is ready to be retested. CCxR reschedules test and test is repeated until satisfactory performance is achieved.

3. Cost of Retesting: Costs for retesting shall be charged to Contractor.

OPERATIONS AND MAINTENANCE TRAINING

Training: Develop Training Plan. Coordinate and execute training programs with CxA.

1. Stress and enhance importance of system interactions, troubleshooting, and long-term preventive maintenance and operation programs.
2. TRAINING OF FACILITY OPERATING STAFF AND BUILDING OCCUPANTS
3. Training of facility operating staff and building occupants specified in other Sections of this Specification is subject to the observation and review of the Commissioning Agent.
4. Submit a detailed Training Plan for review of the Commissioning Agent prior to beginning training.
5. Training Plan includes a description of each training session, including topics, attendees, instructor(s), methods, location, duration, and schedule.
6. Training not to begin until Functional Testing has been successfully completed.

EQUIPMENT & SYSTEM SCHEDULE

Commissioned Equipment and Systems: Reference associated pre-functional checklists and functional testing forms for equipment and systems.

1-05.12 Final Acceptance

The Contractor must perform all the obligations under the Contract before a Completion Date and final acceptance can occur. Failure of the Contractor to perform all the obligations under the Contract shall not bar the Contracting Agency from unilaterally accepting the Contract as provided in Section 1-09.9. The Contracting Agency accepts the completed Contract and the items of Work shown in the final estimate by signature of the Final Contract Voucher Certification. The date of that signature constitutes the acceptance date. Progress estimates or payments shall not be construed as acceptance of Work under the Contract.

The Contractor agrees that neither completion nor final acceptance shall relieve the Contractor of the responsibility to indemnify, defend, and protect the Contracting Agency against all claims or loss resulting from the failure of the Contractor or subcontractors to pay all laborers, mechanics, subcontractors, material persons, or others who provides labor, supplies, or provisions for carrying out the Work or for payments required for unemployment compensation under Title 50 RCW or for industrial insurance and medical aid required under Title 51 RCW.

Final acceptance shall not constitute acceptance of unauthorized or defective work or

material. The Contracting Agency shall not be barred from requiring the Contractor to remove, replace, repair, or dispose of all unauthorized or defective work or material or from recovering damages for any such work or material.

1-05.13 Superintendents, Labor, and Equipment of Contractor

At all times, the Contractor shall keep at the Work site a set of the Plans, Specifications, Special Provisions, and Addenda. The Contractor shall devote the attention required to make progress on the Work in accordance with their approved schedule. The Contractor shall cooperate fully with the Engineer and Inspectors.

Either the Contractor in person or an authorized representative shall remain on site whenever the Work is underway. Before the Work begins, the Contractor shall name in writing an experienced superintendent who understands the Contract and is able to supervise the Work. This superintendent shall have full authority to represent and act for the Contractor. Superintendents who repeatedly fail to follow the Engineer's written or oral orders, directions, instructions, or determinations, shall be subject to removal from the project. Upon the written request of the Engineer, the Contractor shall immediately remove such superintendent and name a replacement in writing.

Competent supervisors experienced in the task being performed shall continuously oversee the Contract Work. At the Engineer's written request, the Contractor shall immediately remove and replace incompetent, careless, or negligent employees.

Noncompliance with the Engineer's request to remove and replace personnel at any level shall be grounds for terminating the Contract under the terms of Section 1-08.10.

The Contractor shall keep all machinery and equipment in good, workable condition. It shall be adequate for its purpose and used by competent operators.

1-05.13(1) Emergency Contact List

The Contractor shall submit an Emergency Contact List to the Engineer as a Type 1 Working Drawing no later than 5 calendar days after the date the Contract is executed. The list shall include, at a minimum, the Contractor's Project Manager, or equivalent, the Contractor's Project Superintendent, the Erosion and Sediment Control (ESC) Lead, and the Traffic Control Supervisor. The list shall identify a representative with delegated authority to act as the emergency contact on behalf of the Contractor and include one or more alternates. The emergency contact shall be available upon the Engineer's request at other than normal working hours. The Emergency Contact List shall include 24-hour telephone numbers for all individuals identified as emergency contacts or alternates.

1-05.14 Vacant

1-05.15 Method of Serving Notices

Written notices to the Contractor required under these Specifications may be served on the Contractor either personally or by mailing or by delivery to the last post office or email address known to the Engineer.

All correspondence from the Contractor shall be directed to the Engineer. All correspondence from the Contractor constituting any notification, notice of protest, notice of dispute, or other correspondence constituting notification required to be furnished under the Contract, shall be delivered as an attachment to an email to the

Engineer's office and the Contacting Agency's project management software (Procore), as described below.

Notices delivered by email shall be sent to all addresses on a mutually agreed upon list of addresses for the Contractor and the Contracting Agency. The list shall be agreed upon prior to issuance of the "Notice to Proceed with Construction" and shall be maintained by the Engineer. An email is deemed to be received by the end of the next business day following the date and time as recorded by the device used by the sender from which the email was sent. Email notifications shall have a subject line containing at least the project name and the word Notification (North Kitsap Service Center – Notification). Attachments over 10 megabytes are not allowed. For files over 10 megabytes, a link to a secure file transfer service shall be provided. Confirmation of receipt of email notification shall be provided by the recipient no later than one business day following receipt of the email notification. The Contacting Agency's project management software (Procore) provides for time delivery tracking.

Method of serving notices may be altered at the pre-construction meeting, with meeting notes documenting the approved method.

1-05.16 Water and Power

The Contractor shall make necessary arrangements and shall bear the costs for power and water necessary for the performance of the work unless the contract includes power and water as a pay item.

1-05.17 Project Management Communications

1-05.17(1) Summary

The Contractor shall use the communications tool and protocols included in the Contracting Agency's project management software (Procore) during this project and will have access to it at no cost to the Contractor for the duration of the project. The use of project management communications as herein described does not replace or change any contractual responsibilities of the participants.

A valid email address, electronic and computer equipment, and internet connections are the responsibility of each project participant. The Contracting Agency will set up the user account.

Nothing in this specification or the subsequent communications supersedes the parties' obligations and rights for copyright or document ownership as established by the Contract Documents. The use of CAD files, processes or design information distributed in this system is intended only for the project specified herein.

1-05.17(2) Training & Support

The Contracting Agency will host an information and training session for Contractor staff in use of the Contracting Agency's project management software at a time to be schedule after contract award. Companies may also use online videos, support articles, online chat and phone support provided by the Contracting Agency's project management software at no cost.

1-05.17(3) Project Archive

The archive will be available to the Contractor at no cost. The archive set will contain only documents that the Contractor has access to during construction. All legal rights in any discovery process are retained. Archive material shall be ordered through the Contracting Agency.

1-05.17(4) Authorized Users

Access to the Contracting Agency's project management software will be by individuals who have been authorized to use it by the Engineer.

1. The Contracting Agency will provide the Contractor with at least five (5) access accounts for the duration of the project. The sharing of user accounts is prohibited.
2. Contractor shall provide Engineer with a list of proposed Authorized users including valid email addresses following award of the Contract and scheduling of Contracting Agency provided training.
3. Authorized users will be contacted via e-mail with log-in information.
4. Individuals shall be responsible for the proper use of their passwords and access to data as agents of the Contractor.
5. Only entities with a direct Contract with the Contracting Agency will be allowed to have read/write access (Authorized user) to the software. Read access may be provided to others, if beneficial to the project, including subcontractors and utility providers.

1-05.17(5) Communications

The use of fax, email and courier communication for this project is discouraged in favor of using the Contracting Agency's project management software to send messages. Communication functions are as follows:

1. Document Integrity and Revisions:
    a. Documents, comments, drawings, and other data posted to the system remain a permanent component of the project. The originator, time and date are recorded for each document submitted to the system. Submitting a new document or record with a unique ID, originator, and time stamp is the method used to make modifications or corrections.
    b. The system identifies revised or superseded documents and their predecessors.
    c. Server or Client-side software enhancements during the life of the project will not alter or restrict the content of data published by the system. System upgrades will not affect access to older documents or software.
2. Document Security: The system provides a method for communication of documents. Documents allow security group assignment to respect the contractual parties' communication with the exception that the Contracting Agency Administrative Users have access to everything. **DO NOT POST PRIVATE OR CONFIDENTIAL ITEMS IN THE DATABASE.**

3. Document Integration: Documents of various types are able to be logically related to one another. For example, requests for information (RFIs), inspector's daily field reports (IDRs), supplemental sketches and photographs can be referenced as related records.
4. Reporting: The system is capable of generating reports for work in progress, and logs for each document type. Summary reports generated by the system are available for project members and are subject to each user's security settings.
5. Notifications and Distribution: Document distribution to project members may be accomplished both within the Contracting Agency's project management software and via email depending on user settings. Project document distribution to parties outside of the project communication system may be accomplished by secure email of outgoing documents and attachments, readable by a standard email client.
6. Except for paper documents which require original signatures and large format documents (greater than 11 x 17 inches), all other documents shall be submitted by transmission in electronic form into the Contracting Agency's project management software by Authorized users.
    1. Large format documents may be transmitted by hardcopy and electronically via the Contracting Agency's project management software as otherwise agreed, or as otherwise noted in the specifications.
    2. Document Types that shall be transmitted via the Contracting Agency's project management software include, but are not limited to:
        i. Request for Information (RFI)
        ii. Change Order (CO)
        iii. Submittals
        iv. Transmittals, including record of documents and materials delivered in hard copy
        v. Meeting Minutes/Notes
        vi. Application for Payments
        vii. Review Comments
        viii. Inspector's Daily Field Reports (IDR)
        ix. Construction Photographs
        x. Drawings
        xi. Supplemental Sketches
        xii. Schedules
        xiii. Specifications

1-05.17(6) Record Keeping

1. The Contracting Agency and their representatives and the Contractor shall respond to electronic documents received from the Contracting Agency's project management software and consider them as if received in paper document form.
2. The Contracting Agency and their representatives and the Contractor reserve the right to reply or respond through the Contracting Agency's project management software to documents actually received in paper document form.
3. The following are examples of paper documents which will require an original signature:
    a. Contract
    b. Change Orders
    c. Application & Certificates for Payment
    d. Force Account and Protested Force Account forms
    e. Correspondence by the Contractor constituting notification per Section 1-05.15 of the Special Provisions.

1-05.17(7) Minimum Equipment Requirements

In addition to other requirements specified in this Section, the Contractor shall be responsible for providing suitable tools and internet access to utilize the Contracting Agency's project management software. Contact Procore:https://support.procore.com/.

No separate payment will be made for the use of the Contracting Agency's project management software, as this will be considered incidental to the Contract. All costs incurred to carry out the requirements of utilizing and maintaining the Contracting Agency's project management software, including but not limited to, labor, training, equipment, and required tools are the sole responsibility of the Contractor.

1-05.18 Record Drawings

The Contractor shall maintain one set of full-size plans for Record Drawings, updated with clear and accurate red-lined field revisions on a daily basis, and within 2 business days after receipt of information that a change in Work has occurred. The Contractor shall not conceal any work until the required information is recorded.

This Record Drawing set shall be used for this purpose alone, shall be kept separate from other Plan sheets, and shall be clearly marked as Record Drawings. These Record Drawings shall be kept on site at the Contractor's field office, and shall be available for review by the Contracting Agency at all times. The Contractor shall bring the Record Drawings to each progress meeting for review.

The preparation and upkeep of the Record Drawings is to be the assigned responsibility of a single, experienced, and qualified individual. The quality of the Record Drawings, in terms of accuracy, clarity, and completeness, is to be adequate to allow the Contracting Agency to modify the computer-aided drafting (CAD) Contract Drawings to produce a complete set of Record Drawings for the Contracting Agency without further investigative effort by the Contracting Agency.

The Record Drawing markups shall document all changes in the Work, both concealed and visible. Items that must be shown on the markups include but are not limited to:

- Actual dimensions, arrangement, and materials used when different than shown in the Plans.
- Changes made by Change Order or Field Order.
- Changes made by the Contractor.
- Accurate locations of all utilities and appurtenances, structures, conduits, light standards, vaults, sidewalks, building footprints, etc. Include pipe invert elevations, top of castings (manholes, inlets, etc.).

The applicable tolerance limits include, but are not limited to the following:

	Vertical	Horizontal
As-built sanitary & storm invert and grate elevations	± 0.01 foot	± 0.01 foot
As-built monumentation	± 0.001 foot	± 0.001 foot
As-built waterlines, inverts, valves, hydrants	± 0.10 foot	± 0.10 foot
As-built ponds/swales/water features	± 0.10 foot	± 0.10 foot
As-built buildings (fin. Floor elev.)	± 0.01 foot	± 0.10 foot
As-built gas lines, power, TV, Tel, Com	± 0.10 foot	± 0.10 foot

Making Entries on the Record Drawings:

- Use erasable colored pencil (not ink) for all markings on the Record Drawings, conforming to the following color code:
  - Additions – Red
  - Deletions – Green
  - Comments – Blue
  - Dimensions – Graphite
- Provide the applicable reference for all entries, such as the change order number, the request for information (RFI) number, or the approved shop drawing number.
- Date all entries.
- Clearly identify all items in the entry with notes similar to those in the Contract Drawings (such as pipe symbols, centerline elevations, materials, pipe joint abbreviations, etc.).

The Contractor shall certify on the Record Drawings that said drawings are an accurate depiction of built conditions, and in conformance with the requirements detailed above. The Contractor shall submit final Record Drawings to the Contracting Agency.

Contracting Agency acceptance of the Record Drawings is one of the requirements for achieving Physical Completion.

Payment will be made for the following bid item:

"Record Drawings (Minimum Bid $30,000)," per Lump Sum

Payment for this item will be made on a prorated monthly basis for work completed in accordance with this section up to 75% of the lump sum bid. The final 25% of the lump sum item will be paid upon submittal and approval of the completed Record Drawings set prepared in conformance with these Special Provisions.

A minimum bid amount has been entered in the Bid Proposal for this item. The Contractor must bid at least that amount.

1-06 Control of Material

1-06.0 Submittal Procedures

Contractor submittals shall be in accordance with the following:

Submittals will be submitted per the specified process and naming convention which will be defined at the Pre-construction Meeting.

The Contractor shall thoroughly review each submittal for dimensions, quantities, and details of the material or item shown and correct any errors, omissions, or deviations with the Contract Documents. The Contractor shall accept full responsibility for the completeness of each submittal.

Each submittal shall have a unique number assigned to it (via the Contracting Agency's project management software). On each page, indicate the page number, and total number of pages in each submittal.

Each submittal shall indicate the following:

1. The intended use of the item in the work;
2. Clearly indicate only applicable items on any catalog cut sheets;
3. The current revision, issue number, and data shall be indicated on all drawings and other descriptive data.
4. Description of Submittal.
5. Related Specification Section and/or plan sheet.
6. Each material submittal shall clearly indicate the name and address of all suppliers, processors, distributors, and/or producers from which the Contractor directly purchased each material.

When submitting product data, the Contractor shall modify drawings to delete any information not applicable to the project and add information that is applicable to the project. The Contractor shall mark copies of printed material to clearly identify the pertinent materials, products or models.

Samples submitted shall be of sufficient size and quantity to clearly illustrate functional characteristics of product or material and full range of colors available. Field samples

and mock-ups, where required, shall be erected at the project site where directed by the Engineer.

The Contractor shall notify the Engineer, in writing at time of submission, of deviations in submittals from requirements of the contract documents.

The Contracting Agency shall not be responsible for delays in reviewing submittals not submitted in accordance with these specifications.

Review or approval of Working Drawings shall neither confer upon the Contracting Agency nor relieve the Contractor of any responsibility for the accuracy of the drawings or their conformity with the Contract. The Contractor shall bear all risk and all costs of any Work delays caused by rejection or non-approval of Working Drawings.

1-06.0(1) Engineer's Review of Submittals

The Engineer's review of drawings and data submitted by the Contractor will cover only general conformity with the Contract drawings and specifications. The Engineer's review of submittals shall not relieve the Contractor from responsibility for errors, omissions, deviations, or responsibility for compliance with the Contract documents.

Review of a separate item does not constitute review of an assembly in which the item functions.

When the submittal or resubmittal is marked "APPROVED," "APPROVED AS NOTED," "REVIEWED & FILED" AND "CONDITIONALLY APPROVED" no resubmittal is required. When the submittal is marked "REVIEWED WITH COMMENTS" the Contractor shall comply with any comments on the return submittal.

1-06.0(2) Resubmittals

When a submittal is marked "REVISE AND RESUBMIT" or "REJECTED," the Contractor shall make the corrections as noted and instructed by the Engineer and resubmit via the Contracting Agency's project management software. The Contractor shall not install material or equipment that has received a review status of "REVISE AND RESUBMIT" or REJECTED."

When corrected copies are resubmitted, the Contractor shall in writing direct specific attention to all revisions and shall list separately any revision made other than those called for by the Engineer on previous submittals. The Contracting Agency's project management software will assign the resubmittal number of the original submittal followed by a revision number (1, 2, etc.) to indicate the sequence of the resubmittal.

Each submittal shall have a unique number assigned to it (via the Contracting Agency's project management software).

The Contractor shall revise returned submittals as required and resubmit until final review is obtained. Any associated progress delay due to the Contractor's need to revise and resubmit is the Contractor's sole responsibility.

The Contractor shall verify that all exceptions previously noted by the Engineer have been accounted for.

1-06.0(3) Submittal Control Document

The Contractor shall prepare and maintain a Submittal Control Document listing all anticipated submittals. The plan shall be formatted to allow tracking of submittal status including scheduled date of initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, name of (sub)contractor, actual date of submittal, date of review, status (approved, revise and resubmit, etc.), date of returned submittal, and date of approval.

The Submittal Control Document shall be coordinated with the Progress Schedule and the Schedule of Values, updated and submitted with each pay request.

1-06.1 Approval of Materials Prior to Use

Prior to use, the Contractor shall notify the Engineer of all proposed materials. The Contractor shall use the Qualified Product List (QPL), the Aggregate Source Approval (ASA) Database, or the Request for Approval of Material (RAM) form.

All equipment, materials, and articles incorporated into the permanent Work:

1. Shall be new, unless the Special Provisions permit otherwise;
2. Shall meet the requirements of the Contract and be approved by the Engineer;
3. May be inspected or tested at any time during their preparation and use; and
4. Shall not be used in the Work if they become unfit after being previously approved.

1-06.1(1) Qualified Products List (QPL)

The QPL is a listing of manufactured products that have been evaluated and determined suitable for use in Highway construction.

If the Contractor elects to use the QPL, the most current list available at the time the product is proposed for use, shall be used. The QPL submittal shall be prepared by the Contractor in accordance with the instructions in the QPL and submitted to the Engineer prior to use.

The QPL identifies the approved products, the applicable Specification Section, and the basis for acceptance at the project level. The listing is divided into two categories, “Approved” and “Conditionally Approved.” “Approved” products are denoted with an “A.” Those products may be accepted without additional sampling. “Conditionally Approved” products are denoted with a “CA.” The acceptance and use of these products is based upon additional job sampling and/or documentation. All additional acceptance actions need to be completed prior to the material being incorporated into the Work.

The Contractor shall advise the Engineer of the intended items for use from the QPL by reference to the Contract Bid item.

The use of listed products shall be restricted to the Standard Specification for which they are listed and fulfillment of the acceptance requirement defined in the QPL. Qualified products not conforming to the Specifications, not fulfilling the acceptance requirements, or improperly handled or installed, shall be replaced at the Contractor’s expense.

To qualify for continued listing on the QPL, products may be sampled and tested for conformance to the *Standard Specifications*. The Contracting Agency reserves the right to make revisions to the QPL at any time.

If there is a conflict between the QPL and the Contract, the provisions of the Contract shall take precedence over the QPL.

The current QPL can be accessed online at www.wsdot.wa.gov/business/materialslab/QPL.htm.

1-06.1(2) Request for Approval of Material (RAM)

The RAM shall be used when the Contractor elects not to use the QPL or the material is not listed in the QPL. The RAM shall be prepared by the Contractor in accordance with the instructions on Form 350-071 and submitted to the Engineer for approval before the material is incorporated into the Work.

Approval of the material does not constitute acceptance of the material for incorporation into the Work.

Additional acceptance actions as noted on the RAM need to be completed prior to the materials being incorporated into the Work.

When requesting approval of an item that requires fabrication, both the fabricator and the manufacturer of the base material shall be identified on the RAM.

1-06.1(3) Aggregate Source Approval (ASA) Database

The ASA database contains the results of WSDOT preliminary testing of aggregate sources as well as the results pertaining to the review of the aggregate source Quality Control Programs. Aggregate sources evaluated after January 1, 2021 shall have Quality Control Program compliant with QC 11 and QC 12.

This database is used by the Contracting Agency to indicate the approval status of these aggregate sources for applications that require preliminary testing as defined in the Contract. The ASA '*Aggregate Source Approval* Report' identifies the currently approved applications for each aggregate source listed. The acceptance and use of these aggregates is contingent upon additional job sampling and/or documentation. The ASA database can be accessed online at the agency website.

Aggregates approved for applications on the ASA '*Aggregate Source Approval* Report' not conforming to the Specifications, not fulfilling the acceptance requirements, or improperly handled or installed, shall be replaced at the Contractor's expense.

Aggregate materials that are not approved for use in the ASA data base may be sampled and tested by the Agency, for a specified use on a project, from the source or from a processed stockpile of the material and all cost for the sampling and testing will be deducted from the Contract.

The Contractor agrees to authorize the Engineer to deduct the sampling and testing costs from money due or coming due to the Contractor.

Regardless of the status of the aggregate source, whether listed or not listed in the ASA database the Contractor shall provide toxicity test results on the aggregate source in accordance with Section 9-03.21(1) upon request from the Engineer.

1-06.2 Acceptance of Materials

1-06.2(1) Samples and Tests for Acceptance

The Contractor shall deliver representative samples (from the Contractor, Producer, or

Fabricator) to the Engineer without charge before incorporating material into the Work. In providing samples, the Contractor shall provide the Engineer with sufficient time and quantities for testing before use. The Engineer may require samples at any time. Samples not taken by or in the presence of the Engineer will not be accepted for test, unless the Engineer permits otherwise.

The Contractor shall designate specific Contractor employees as points of contact for concrete testing and acceptance. Alternates shall be designated to ensure that direct contact is maintained during concrete placement. If designated by the Contractor to the Engineer, the concrete supplier will receive all 28-day concrete strength test results.

The Engineer will designate specific Contracting Agency employees as points of contact for concrete testing and acceptance.

The Contractor may observe any of the sampling and testing performed by the Engineer. If the Contractor observes a deviation from the specified sampling and testing procedures, the Contractor shall verbally describe the deviations observed to the Engineer or designated representative immediately, and shall confirm these observed deviations in writing to the Engineer within 24 hours, referencing the specific procedures and steps. The Engineer will respond in writing within 3 working days of the receipt of the Contractor's written communications.

All field and Laboratory materials testing by the Engineer will follow methods described in Contract documents, or in the WSDOT *Materials Manual* M 46-01, using qualified testing personnel and calibrated or verified equipment. The standard or tentative standard in effect on the Bid advertising date will apply in each case.

Revisions to the WSDOT *Materials Manual* M 46-01 or revisions to other Specifications or test methods such as AASHTO, ASTM, or Federal Specifications will be considered as in effect 60 calendar days after publication.

1-06.2(2) Vacant

1-06.3 Manufacturer's Certificate of Compliance

When authorized by these Specifications or the Special Provisions and prior to use, the Engineer may accept certain materials on the basis of a Manufacturer's Certificate of Compliance as an alternative to material inspection and testing.

The Contractor may request, in writing, authority from the Engineer to install such materials prior to submitting the required certification; however, no payment will be made for the Work in the absence of an acceptable Manufacturer's Certificate of Compliance. The Contracting Agency reserves the right to deny the request for good cause. If for any reason the Contractor has not provided an acceptable Manufacturer's Certificate of Compliance by the Physical Completion Date established by Section 1-08.5, the Contracting Agency will assess the usefulness of the installed material. At the Engineer's discretion, the Contracting Agency will either require replacement of the material by the Contractor at no expense to the Contracting Agency or process the final payment as provided by Section 1-09.9 without paying for the materials or any portion of the Work performed to install the materials provided on such a basis. The unit Contract prices for the Work shall be used to determine the amount to be withheld. Where unit Contract prices do not exist, as in a lump sum item, the amount to be withheld shall be an equitable adjustment, covering labor, equipment and materials, determined in

accordance with Section 1-09.4.

The Manufacturer's Certificate of Compliance must identify the manufacturer, the type and quantity of material being certified, the applicable Specifications being affirmed, and the signature of a responsible corporate official of the manufacturer and include supporting mill tests or documents. A Manufacturer's Certificate of Compliance shall be furnished with each lot of material delivered to the Work and the lot so certified shall be clearly identified in the certificate.

All materials used on the basis of a Manufacturer's Certificate of Compliance may be sampled and tested at any time. Materials not conforming to the requirements will be subject to rejection whether in place or not. The Contracting Agency reserves the right to refuse to accept materials on the basis of a Manufacturer's Certificate of Compliance.

1-06.4 Handling and Storing Materials

In storage and handling, the Contractor shall protect materials against damage from careless handling, from exposure to weather, from mixture with foreign matter, and from all other causes. The Engineer will reject and refuse to test materials improperly handled or stored.

The Contractor shall repair, replace, or make good all Contracting Agency-provided materials that are damaged or lost due to the Contractor's operation or while in the Contractor's possession, at no expense to the Contracting Agency.

1-06.5 Owners Manuals and Operating Instructions

For equipment and materials that are permanently incorporated in the Work, the Contractor shall provide to the Engineer all owners manuals and operating instructions furnished by the equipment or material manufacturer.

Operation and maintenance manuals shall be prepared by the Contractor and include contents in accordance with the following:

Assembly of Operation and Maintenance Manuals

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents and tag numbers.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper. Illegible material will not be accepted.

I. Drawings: Provide 11” by 17” sheets with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

Data - General

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

E. Warranties and Bonds: Include in Manual, indexed separately on Table of Contents.

Data for Materials and Finishes

A. For Each Product, Applied Material, and Finish:

1. Product data, with catalog number, size, composition, and color and texture designations.

2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional information as specified in individual product specification sections.

E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

Data for Equipment and Systems

A. For Each Item of Equipment and Each System:
    1. Description of unit or system, and component parts.
    2. Identify function, normal operating characteristics, and limiting conditions.
    3. Include performance curves, with engineering data and tests.
    4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

D. Include color coded wiring diagrams as installed.

E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
    1. Include HVAC outdoor and exhaust air damper calibration strategy.
        a. Include provisions which ensure that full closure of dampers can be achieved.
    2. Include Carbon Dioxide Monitoring Protocol.
    3. Include Carbon Monoxide Monitoring Protocol.
    4. Include Frost Mitigation Strategy for ventilation heat-recovery system.

G. Provide servicing and lubrication schedule, and list of lubricants required.

H. Include manufacturer's printed operation and maintenance instructions.

I. Include sequence of operation by controls manufacturer.

J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

K. Provide control diagrams by controls manufacturer as installed.

L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

O. Include test and balancing reports.

P. Additional Requirements: As specified in individual product specification sections.

Training

The Contractor shall provide demonstrations or training when required in accordance with the following:

Demonstration Procedures

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstration may be combined with Owner personnel training if applicable.

C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.

1. Perform demonstrations not less than two weeks prior to Substantial Completion.

2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.

1. Perform demonstrations not less than two weeks prior to Substantial Completion.

Training Procedures

A. Conduct training on-site unless otherwise indicated.

B. Provide training in minimum two hour segments.

C. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

D. Review of Facility Policy on Operation and Maintenance Data: During training discuss:

1. The location of the O&M manuals and procedures for use and preservation; backup copies.

2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.

3. Typical uses of the O&M manuals.

E. Product- and System-Specific Training:

1. Review the applicable O&M manuals.
2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
4. Provide hands-on training on all operational modes possible and preventive maintenance.
5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
6. Discuss common troubleshooting problems and solutions.
7. Discuss any peculiarities of equipment installation or operation.
8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
9. Review recommended tools and spare parts inventory suggestions of manufacturers.
10. Review spare parts and tools required to be furnished by Contractor.
11. Review spare parts suppliers and sources and procurement procedures.

F. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

1-06.6 Recycled Materials

The Contractor shall make their best effort to utilize recycled materials in the construction of the project. Approval of such material use shall be as detailed elsewhere in the Standard Specifications.

1-06.7 Substitutions

1-06.7(1) General Requirements

The following applies to substitution requests during the bid phase and the construction phase of the project.

1. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   a. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   b. Agrees to provide the same warranty for the substitution as for the specified product.
   c. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.

d. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Contracting Agency.

e. Waives claims for additional costs or time extension that may subsequently become apparent.

f. Agrees to reimburse the Contracting Agency for review or redesign services associated with re-approval by authorities.

2. The submitter shall document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.

   a. Note explicitly any non-compliant characteristics.

3. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.

   a. Forms indicated in the Project Manual are adequate for this purpose, and must be used.

4. Limit each request to a single proposed substitution item.

   a. Submit an electronic document, combining the request form with supporting data into single document.

1-06.7(1)A Substitution Procedures During Bid

1. Submittal Time Restrictions: Substitution requests shall be made no later than one week prior to the bid opening date.

2. Submittal Form (before award of contract): CSI/CSC Form 1.5C – this form will be supplied by the Contracting Agency.

   a. Submit substitution requests by completing the form attached to this section to Jacques Dean, Road Superintendent at (360) 337-4671, or Jdean@kitsap.gov. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

1-06.7(1)B Substitution Procedures During Construction

1. Submittal Form (after award of contract): CSI/CSC Form 13.1A – this form will be supplied by the Contracting Agency.

   a. Submit substitution requests by completing the form to the Contracting Agency. See this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.

2. If the Substitution request is submitted in order to stay on approved project schedule, the Contractor shall:

   a. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.

b. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.

c. Bear the costs engendered by proposed substitution of:

I. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.

II. Other construction by Owner.

III. Other unanticipated project considerations.

3. Substitutions will not be considered under one or more of the following circumstances:

a. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.

b. Without a separate written request.

c. When acceptance will require revisions to Contract Documents.

1-06.7(1)C Resolution

1. The Engineer may request additional information and documentation prior to rendering a decision. The Contractor shall provide this data in an expeditious manner.
2. The Engineer will notify Contractor in writing of decision to accept or reject request.

a. The Engineer's decision following review of proposed substitution will be noted on the submitted form.

1-06.7(1)D Acceptance

1. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, RFI, Submittal, Supplementary Instructions, or similar instruments.

1-06.7(1)E Closeout Activities

1. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

1-06.7(1)F Forms

1. The Substitution Request Forms are as follows, and can be found on-line:

a. CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage) Current Edition.

b. CSI/CSC Form 13.1A - Substitution Request (After the Bidding/Negotiating Phase) Current Edition.

1-06.8 Mockups

Where mockups are required, the Contractor shall comply with the following:

1. Construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated

for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

2. Accepted mock-ups establish the standard of quality the Engineer will use to judge the Work.
3. Construct integrated exterior mock-up as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials, as necessary.
4. Notify Engineer fifteen (15) working days in advance of dates and times when mock-ups will be constructed.
5. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.
6. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
7. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
8. Obtain Engineer's approval of mock-ups before starting work, fabrication, or construction.
9. The Contractor’s schedule shall allow the Engineer up to seven (7) working days of to provide written comments of the initial review and again for each subsequent follow up review of each mock-up.
10. Make corrections as necessary until Engineer's approval is issued.
11. Where mock-up has been accepted by the Engineer and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by the Engineer.
12. Where possible salvage and recycle the demolished mock-up materials.

1-06.9 Maintenance Materials

Where mockups are required, the Contractor shall comply with the following:

1. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
2. Deliver to Project site; obtain receipt prior to final payment.

1-07 Legal Relations and Responsibilities to the Public

1-07.1 Laws to be Observed

1-07.1(1) General

The Contractor shall always comply with all Federal, State, tribal, or local laws, ordinances, and regulations that affect Work under the Contract. The Contractor shall indemnify, defend, and save harmless the State (including the Governor, Commission, Secretary, and agents, officers, and employees) against claims that may arise because

the Contractor (or employees of the Contractor, subcontractors or material persons) violated a legal requirement.

Without usurping the authority of other agencies, the Contracting Agency will cooperate with them in their efforts to enforce legal requirements. Upon awareness of a violation of a legal requirement, the Engineer will notify the Contractor in an effort to achieve compliance. The Engineer may also notify the agency responsible for enforcement if the Engineer deems that action is necessary to achieve compliance with legal requirements. The Engineer will also assist the enforcement agency to obtain Contractor compliance to the extent such assistance is consistent with the provisions of the Contract

In cases of conflict between different safety regulations, the more stringent regulation shall apply.

The Washington State Department of Labor and Industries shall be the sole and paramount administrative agency responsible for the administration of the provisions of the Washington Industrial Safety and Health Act of 1973 (WISHA).

The Contractor shall maintain at the project site office, or other well-known place at the project site, all articles necessary for providing first aid to the injured. The Contractor shall establish, publish, and make known to all employees, procedures for ensuring immediate removal to a hospital, or doctor's care, persons, including employees, who may have been injured on the project site. Employees should not be permitted to work on the project site before the Contractor has established and made known procedures for removal of injured persons to a hospital or a doctor's care.

The Contractor shall have sole responsibility for the safety, efficiency, and adequacy of the Contractor's plant, appliances, and methods, and for any damage or injury resulting from their failure, or improper maintenance, use, or operation. The Contractor shall be solely and completely responsible for the conditions of the project site, including safety for all persons and property in the performance of the work. This requirement shall apply continuously, and not be limited to normal working hours. The required or implied duty of the Engineer to conduct construction review of the Contractor's performance does not, and shall not, be intended to include review and adequacy of the Contractor's safety measures in, on, or near the project site.

1-07.1(2) Health and Safety

The Contractor shall be responsible for the safety of all workers and shall comply with all appropriate state safety and health standards, codes, rules, and regulations, including, but not limited to, those promulgated under the Washington Industry Safety and Health Act RCW 49.17 (WISHA) and as set forth in Title 296 WAC (Department of Labor and Industries). In particular the Contractor's attention is drawn to the requirements of WAC 296.800 which requires employers to provide a safe workplace. More specifically WAC 296.800.11025 prohibits alcohol and narcotics from the workplace. The Contractor shall likewise be obligated to comply with all federal safety and health standards, codes, rules, and regulations that may be applicable to the Contract Work. A copy of all safety plans (e.g., fall protection work plan) that are developed by the Contractor shall be submitted to the Engineer as a Type 1 Working Drawing. When requested by the Engineer, the Contractor shall provide training to Contracting Agency employees working on-site for any activity covered by a safety plan.

Costs for training that is provided solely to Contracting Agency employees will be paid to the Contractor in accordance with Section 1-09.4.

1-07.1(3) Mine Safety

U.S. Mine Safety and Health Administration rules apply when the project includes pit or quarry operations. Among other actions, these regulations require the Contractor to notify the nearest Mine Safety and Health sub district office (1) of the project before it begins, (2) of the starting date, and (3) of the Physical Completion Date.

1-07.1(4) Wells

When wells are included in the contract or encountered as part of the Work, the Contractor shall meet all the requirements in WAC 173-160 Minimum Standards for Construction and Maintenance of Wells and all environmental considerations for installing, protecting in place, decommissioning, or abandonment of wells.

1-07.1(5) Changes to Laws to be Observed

1-07.1(5)A General

The Contracting Agency will not adjust payment to compensate the Contractor for changes in legal requirements unless those changes are specifically within the scope of RCW 39.04.120. For changes under RCW 39.04.120, the Contracting Agency will compensate the Contractor by negotiated change order as provided in Section 1-04.4.

1-07.1(5)B Taxes

Under certain conditions, the Contracting Agency will adjust payment to compensate for tax changes. First, the changes shall involve federal or state taxes on materials or fuel used in or consumed for the project. Second, the changes shall increase or decrease Contractor-paid taxes by more than $500. For items in the original Contract, the tax change must occur after the Bid opening date. For negotiated Contracts or items in a supplemental agreement, the tax change must take place after the execution date of the Contract or agreement. Within these conditions, the Contracting Agency will adjust compensation by the actual dollar amounts of increase or decrease caused by the tax changes. If the Engineer requests it, the Contractor shall certify in writing that the Contract price does not include any extra amount to cover a possible change in taxes.

The Contracting Agency may audit the records of the Contractor as provided in Section 1-09.12, to verify claims for compensation because of changes in laws or taxes.

1-07.2 State Taxes

The Washington State Department of Revenue has issued special rules on the State sales tax. Sections 1-07.2(1) through 1-07.2(3) are meant to clarify those rules. The Contractor should contact the Washington State Department of Revenue for answers to questions in this area. The Contracting Agency will not adjust its payment if the Contractor bases a bid on a misunderstood tax liability.

The Contractor shall include all Contractor-paid taxes in the unit bid prices or other contract amounts. In some cases, however, state retail sales tax will not be included. Section 1-07.2(2) describes this exception.

The Contracting Agency will pay the retained percentage (or release the Contract Bond if a FHWA-funded Project) only if the Contractor has obtained from the Washington State Department of Revenue a certificate showing that all contract-related taxes have been paid (RCW 60.28.051). The Contracting Agency may deduct from its payments to the Contractor any amount the Contractor may owe the Washington State Department of Revenue, whether the amount owed relates to this contract or not. Any amount so deducted will be paid into the proper State fund.

1-07.2(1) State Sales Tax: WAC 458-20-171 – Use Tax

WAC 458-20-171, and its related rules, apply to building, repairing, or improving streets, roads, etc., which are owned by a municipal corporation, or political subdivision of the state, or by the United States, and which are used primarily for foot or vehicular traffic. This includes storm or combined sewer systems within and included as a part of the street or road drainage system and power lines when such are part of the roadway lighting system. For work performed in such cases, the Contractor shall include Washington State Retail Sales Taxes in the various unit bid item prices, or other contract amounts, including those that the Contractor pays on the purchase of the materials, equipment, or supplies used or consumed in doing the work.

1-07.2(2) State Sales Tax: WAC 458-20-170 – Retail Sales Tax

WAC 458-20-170, and its related rules, apply to the constructing and repairing of new or existing buildings, or other structures, upon real property. This includes, but is not limited to, the construction of streets, roads, highways, etc., owned by the state of Washington; water mains and their appurtenances; sanitary sewers and sewage disposal systems unless such sewers and disposal systems are within, and a part of, a street or road drainage system; telephone, telegraph, electrical power distribution lines, or other conduits or lines in or above streets or roads, unless such power lines become a part of a street or road lighting system; and installing or attaching of any article of tangible personal property in or to real property, whether or not such personal property becomes a part of the realty by virtue of installation.

For work performed in such cases, the Contractor shall collect from the Contracting Agency, retail sales tax on the full contract price. The Contracting Agency will automatically add this sales tax to each payment to the Contractor. For this reason, the Contractor shall not include the retail sales tax in the unit bid item prices, or in any other contract amount subject to Rule 170, with the following exception.

Exception: The Contracting Agency will not add in sales tax for a payment the Contractor or a subcontractor makes on the purchase or rental of tools, machinery, equipment, or consumable supplies not integrated into the project. Such sales taxes shall be included in the unit bid item prices or in any other contract amount.

1-07.2(3) Services

The Contractor shall not collect retail sales tax from the Contracting Agency on any contract wholly for professional or other services (as defined in Washington State Department of Revenue Rules 138 and 244).

1-07.3 Fire Prevention and Merchantable Timber Requirements

1-07.3(1) Fire Prevention Control and Countermeasures Plan

The Contractor shall prepare and implement a project-specific fire prevention, control, and countermeasures plan (FPCC Plan) for the duration of the project. The Contractor shall submit a Type 2 Working Drawing no later than the date of the preconstruction conference.

1-07.3(1)A FPCC Implementation Requirements

The Contractor's FPCC Plan shall be fully implemented at all times. The Contractor shall update the FPCC Plan throughout project construction so that the plan reflects actual site conditions and practices. The Contractor shall update the FPCC Plan at least annually and maintain a copy of the updated FPCC Plan that is available for inspection on the project site. Revisions to the FPCC Plan and the Industrial Fire Precaution Level (IFPL) shall be discussed at the weekly project safety meetings.

1-07.3(1)A1 FPCC Plan Element Requirements

The FPCC Plan shall include the following:

1. The names, titles, and contact information for the personnel responsible for implementing and updating the plan.
2. The names and telephone numbers of the Federal, State, and local agencies the Contractor shall notify in the event of a fire.
3. All potential fire causing activities such as welding, cutting of metal, blasting, fueling operations, etc.
4. The location of fire extinguishers, water, shovels, and other firefighting equipment.
5. The response procedures the Contractor shall follow in the event of a fire.

Most of Washington State is covered under the IFPL system which, by law, is managed by the Department of Natural Resources (DNR). In some cases jurisdiction is transferred to the United States Forest Service (USFS) or to the local fire authority. It is the Contractor's responsibility to be familiar with the IFPL requirements and to verify whether or not IFPL applies to the specific project.

If the Contractor wishes to continue a work activity that is prohibited under an industrial fire precaution level, the Contractor shall obtain a waiver from the fire authority with jurisdiction and provide a copy to the Engineer prior to continuation of work on the project.

If the IFPL requirements prohibit the Contractor from performing Work the Contractor may be eligible for an unworkable day in accordance with Section 1-08.5.

The Contractor shall comply with the requirements of these provisions at no additional cost to the Contracting Agency.

1-07.3(1)A2 Forest Fire Prevention

When the Work is in or next to State or Federal forests, the Contractor shall know and observe all laws and rules (State or Federal) on fire prevention and sanitation. The Contractor shall ask the local forest supervisor or regional manager to outline requirements for permits, sanitation, firefighting equipment, and burning.

The Contractor shall take precautions to prevent and suppress forest fires. In case of forest fire, the Contractor shall immediately notify the nearest forest headquarters of its exact site and shall make every effort to suppress it. If needed, the Contractor shall require its employees and those of all subcontractors to work under forest officials in fire-control efforts.

1-07.3(2) Merchantable Timber Requirements

Permission for the harvesting of merchantable timber is included as part of the Kitsap County Department of Community Development, Site Development Activity Permit (SDAP) 22-03979 Plan Acceptance of Appendix C. The Contractor shall comply fully with the State Forest Practices Act.

No person may export from the United States, or sell, trade, exchange, or otherwise convey to any other person for the purpose of export from the United States, timber originating from the project.

The Contractor shall comply with the Forest Resources Conservation and Shortage Relief Amendments Act of 1993 (Public Law 103-45) and the Washington State Log Export Regulations (WAC 240-15).

1-07.4 Sanitation

1-07.4(1) General

The Contractor shall provide employees with all accommodations required by the State Department of Health and other agencies. These accommodations shall be kept clean, neat, and sanitized, and shall not create any public nuisance. The Contractor shall keep all campsites clean, properly dispose of all refuse, and leave each site in a neat and sanitary condition.

1-07.4(2) Health Hazards

Biological hazards and associated physical hazards may be present in the worksite. The Contractor shall take precautions and perform all necessary Work to provide and maintain a safe and healthful worksite in accordance with applicable laws. Payment for Work necessary to provide and maintain a safe worksite will be incidental to associated items of Contract Work unless the Contract includes provisions to the contrary.

1-07.5 Environmental Regulations

1-07.5(1) General

No Work shall occur within areas under the jurisdiction of resource agencies unless authorized in the Contract. Some, though not all, of these rules are summarized below. Any of these agencies may, without prejudice to the Contracting Agency, add rules as needed to protect game, fish, or the environment.

The Contractor shall be responsible to immediately report to the Engineer deviations from the contract provisions pertaining to environmental compliance, including but not limited to spills, unauthorized fill in waters of the State including wetlands, water quality standards, noise, air quality, etc.

1-07.5(2) State Department of Fish and Wildlife

In doing the Work, the Contractor shall:

1. Not degrade water in a way that would harm fish, wildlife, or their habitat.
2. Not place materials below or remove them from the ordinary high water line except as may be specified in the Contract.
3. Not allow equipment to enter waters of the State except as specified in the Contract.
4. Revegetate in accordance with the Plans, unless the Special Provisions permit otherwise.
5. Prevent fish-threatening silt buildup on the bed or bottom of any body of water.
6. Ensure continuous stream flow downstream of the Work area.
7. Dispose of all project debris by removal, burning, or placement above high-water flows.
8. Immediately notify the Engineer and stop all work causing impacts, if at any time, as a result of project activities, fish are observed in distress or a fish kill occurs.

1-07.5(3) State Department of Ecology

In doing the Work, the Contractor shall:

1. Comply with Washington State Water Quality Standards.
2. Perform Work in such a manner that all materials and substances not specifically identified in the Contract documents to be placed in the water do not enter waters of the State, including wetlands. These include, but are not limited to, petroleum products, hydraulic fluid, fresh concrete, concrete wastewater, process wastewater, slurry materials and waste from shaft drilling, sediments, sediment-laden water, chemicals, paint, solvents, or other toxic or deleterious materials.
3. Use equipment that is free of external petroleum-based products.
4. Remove accumulations of soil and debris from drive mechanisms (wheels, tracks, tires) and undercarriage of equipment prior to using equipment below the ordinary high water line.
5. Clean loose dirt and debris from all materials placed below the ordinary high water line. No materials shall be placed below the ordinary high water line without the Engineer's approval.
6. When a violation of the Construction Stormwater General Permit (CSWGP) occurs, immediately notify the Engineer and fill out WSDOT Form 422-011, Contractor ECAP Report, and submit the form to the Engineer within 48 hours of the violation.
7. Once Physical Completion has been given, prepare a Notice of Termination (Ecology Form ECY 020-87) and submit the Notice of Termination electronically to the Engineer in a PDF format a minimum of 7 calendar days prior to submitting the Notice of Termination to Ecology.
8. Transfer the CSWGP coverage to the Contracting Agency when Physical Completion has been given and the Engineer has determined that the project site is not stabilized from erosion.
9. Submit copies of all correspondence with Ecology electronically to the Engineer in a PDF format within four calendar days.
10. Comply with WAC 173-160 Minimum Standards for Construction and Maintenance

of Wells.

1-07.5(4) Air Quality

1-07.5(4)A General

The Contractor shall comply with all regional clean air authority and/or State Department of Ecology rules and regulations.

The air quality permit process may include additional State Environment Policy Act (SEPA) requirements. Contractors shall contact the appropriate regional air pollution control authority well in advance of beginning Work.

Requirements included in Federal regulations regarding air quality that applies to the "owner or operator" shall be the responsibility of the Contractor.

1-07.5(4)B Fugitive Dust

The Contractor shall base fugitive dust control on Best Management Practices (BMPs) set forth in the Associated General Contractors of Washington Education Foundation and Fugitive Dust Task Force Pamphlet, "Guide To Handling Fugitive Dust From Construction Projects."

1-07.5(4)C Asbestos Containing Material

When the Work includes demolition or renovation of existing facilities or structures that contains Asbestos Containing Material (ACM) and/or Presumed Asbestos-Containing Material (PACM), the Contractor shall comply with the National Emission Standards for Hazardous Air Pollutants (NESHAP).

1-07.5(5) U.S. Army Corps of Engineers

When temporary fills are permitted, the Contractor shall remove fills in their entirety and the affected areas returned to pre-construction elevations.

If a U.S. Army Corps of Engineers permit is noted in Section 1-07.6 of the Special Provisions, the Contractor shall retain a copy of the permit or the verification letter (in the case of a Nationwide Permit) on the worksite for the life of the Contract. The Contractor shall provide copies of the permit or verification letter to all subcontractors involved with the authorized Work prior to their commencement of Work in waters of the U.S.

1-07.5(6) U.S. Fish and Wildlife Service and National Marine Fisheries Service

The Contracting Agency will provide fish exclusion and handling services if the Work dictates. However, if the Contractor discovers any fish stranded by the project and a Contracting Agency biologist is not available, they shall immediately release the fish into a flowing stream or open water.

1-07.5(7) U.S. Environmental Protection Agency

1-07.5(7)A Waste Manifests

If waste manifests are necessary, they shall be submitted using the EPA's e-Manifest system. The Hybrid Manifest method shall not be used. If a paper copy of the manifest is necessary while in transit, the Contractor shall use one of the paper manifest processes such as Data+Image, Scanned Image, or mailed paper. More information on

e-Manifest is available at the EPA's website at: https://www.epa.gov/e-manifest/how-submit-hazardous-waste-manifest.

1-07.6 Permits and Licenses

The Contracting Agency has obtained the below-listed permit(s) for this project. A copy of the permit(s) is attached as an appendix for informational purposes. Copies of these permits, including a copy of the Transfer of Coverage form, when applicable, are required to be onsite at all times.

Contact with the permitting agencies, concerning the below-listed permit(s), shall be made through the Engineer with the exception of when the Construction Stormwater General Permit coverage is transferred to the Contractor, direct communication with the Department of Ecology is allowed. The Contractor shall be responsible for obtaining Ecology's approval for any Work requiring additional approvals (e.g. Request for Chemical Treatment Form). The Contractor shall obtain additional permits, as necessary. All costs to obtain and comply with additional permits shall be included in the applicable Bid items for the Work involved.

- Department of Ecology Construction Storm Water Permit
- Kitsap County (list permits, e.g. ACUP, building permits)
- Kitsap County Forest Practices Application/Permit
- Kitsap Health On-site Sewer Permit
- WSDOT General Permit
- Kitsap PUD No. 1 Certificate of Water Availability

1-07.7 Load Limits

If the sources of materials provided by the Contractor necessitates hauling over roads other than County roads, the Contractor shall, at the Contractor's expense, make all arrangements for the use of the haul routes.

1-07.7(1) General

While moving equipment or materials on public Highways, the Contractor shall comply with all laws that control traffic or limit loads. The Contract neither exempts the Contractor from such laws nor licenses overloads. At the Engineer's request, the Contractor shall provide the equipment or load data needed to compute the equipment's weight on the Roadway.

All Contractor movement or storage of materials or equipment within the project limits (as shown in the Plans):

1. Legal load limits shall apply on all roads open to and in use by public traffic.
2. Legal load limits shall apply on existing roads not scheduled for major reconstruction under the current Contract.
3. The Contractor may haul overloads (not more than 25 percent above load limits) on newly paved roads (with final lift in place) built under this Contract not open to public traffic if this does not damage completed Work.

4. When moving vehicles or operating equipment on or over structures design for direct bearing of live load, buried structures, culverts, pipes, or retaining walls within the project limits, the Contractor shall meet the load-limit restrictions in Section 1-07.7(2).
5. When storing material on a Structure or retaining wall, the Contractor shall meet the load-limit restrictions in Section 1-07.7(2). These requirements are not intended for long term storage of material.
6. The Contractor shall remain responsible for and pay all repair costs due to loads that caused damage on newly paved roads, new and existing Structures, culverts, pipes and retaining walls.

Unit prices shall cover all costs for operating vehicles or storing materials on or over structures, culverts, pipes, and retaining walls. Nothing in this section affects the Contractor's other responsibilities under these Specifications or under public Highway laws.

Bridges that are under construction shall meet the load restrictions in Section 6-01.6.

1-07.7(2) Load-Limit Restrictions

At the request of the Engineer, the Contractor shall provide supporting documentation of vehicle, equipment or material loads, axle or support dimensions and any additional information used to determine the loads.

1. **Structures Designed for Direct Bearing of Live Loads**
   The gross vehicle weight or maximum load on each axle shall not exceed the legal load limit nor any posted weight limit on a Structure.

   Construction equipment that is not considered a legal vehicle licensed for legal travel on the public Highway, including but not limited to track or steel wheeled vehicles, may operate on a Structure. Gross equipment weight, axle spacing, equipment spacing, and other attributes identified in the Plans shall not be exceeded. When loads are not identified in the Plans, the construction equipment shall not exceed the following load restrictions:

   a. The gross vehicle weight or maximum load on each axle shall not exceed the legal load limit, axle spacing nor posted weight limits on a Structure.
   b. A tracked vehicle with a maximum gross vehicle weight of 40,000 pounds and track contact length no less than 8 feet. The maximum gross vehicle weight may increase by 2,000 pounds for each one foot of track contact length over 8 feet, but shall not exceed 80,000 pounds.
   c. A tracked vehicle with a maximum gross vehicle weight of 20,000 pounds and track contact length less than 8 feet.
   d. No single axle shall exceed 20,000 pounds.
   e. No more than one vehicle shall operate over any Structure at one time.

   Track contact length shall be measured once for two or more parallel tracks.

   The Contractor shall not store construction materials on timber Structures or Structures posted for weight limits. When a structure within the project limits is not posted for weight limits and there is no other reasonable storage space within the project limits, the Contractor may store construction material on the Structure and

shall not exceed the maximum uniformly distributed load and distribution length along the structure per the following table:

Maximum Uniform Load (psf)		
Maximum Distributed Length Along Structure	Structure Width (curb-to-curb)	
	24 feet or less	greater than 24 feet
15 ft	250	160
40 ft	125	80
80 ft	75	50
Full Structure Length	50	35

The load restrictions for storing material or operating equipment shall not be combined and shall apply to the full structure length. Materials that are stored in two or more locations on the same structure shall use the total combined length to determine the maximum load restriction. Vehicle traffic and the Contractor's equipment may operate in the adjacent lanes to the stored materials and shall not be allowed on the structure width that is occupied by the stored materials. Contractor's equipment that is used to deliver or remove stored material with the same structure width shall be considered in combination with all stored materials. This equipment shall be assumed to be uniformly distributed over the largest axle spacing and average axle width.

The Contractor shall immediately remove all dirt, rock, or debris that may gather on the Structure's roadway surface.

2. **Buried Structures**

   Buried Structures shall include reinforced concrete three sided structures, box culverts, split box culverts, structural plate pipe, pipe arch, and underpasses.

   Loads shall not exceed 24,000 pounds on a single axle and 16,000 pounds each on tandem axles spaced less than 10 feet apart. These limits are permitted only if the embankment has: (a) been built to Specifications, and (b) reached at least 3 feet above the top of the buried structure.

   When the embankment has reached 5 feet above the top of the buried structure, the Contractor may increase per-axle loads up to 100,000 pounds if outside wheel spacing is at least 7 feet on axle centers.

3. **Pipe Culverts and Sewer Pipes**

   Pipe culverts and sewer pipes shall include pipe for drainage, storm sewers, and sanitary sewers.

   Loads over pipe culverts and sewer pipes shall not exceed 24,000 pounds on a single axle and 16,000 pounds each on tandem axles spaced less than 10 feet apart.

These limits are permitted only if: (a) the culvert or pipe has been installed and backfilled to Specifications, and (b) the embankment has reached at least 2 feet above the top limit of pipe compaction.

When the embankment has reached 5 feet above the top limit of pipe compaction, the Contractor may increase per-axle loads up to 100,000 pounds if outside wheel spacing is at least 7 feet on axle centers, except that:

a. For Class III reinforced concrete pipes, the embankment shall have risen above the top limit of compaction at least 6 feet.
b. For Class II reinforced concrete pipes, the maximum load for each axle shall be 80,000 pounds if outside wheel spacing is at least 7 feet on axle centers. In this case, the embankment shall have risen above the top limit of compaction at least 6 feet.

4. **Retaining Walls**

Loads above existing and completed retaining walls designed for vehicular loads, where any part of the load is located within half the retaining wall height, shall not exceed the following load restrictions:

a. The gross vehicle weight or maximum load on each axle shall not exceed the legal load limit.
b. Construction equipment and material shall not exceed 250 pounds per square foot.

If necessary and safe to do so, the Engineer may allow higher loads than those allowed under these load-limit restrictions. For loads on or over structures designed for direct bearing of live load, the Contractor shall submit Type 3E Working Drawings consisting of calculations and other supporting information in accordance with the requirements of Section 6-01.6. For loads on or over pipes, culverts, buried structures, and retaining walls the Contractor shall submit Type 2E Working Drawings. All submittals shall contain the following information: a description of the loading details; arrangement, movement and position of all vehicles, equipment and materials on the Structure, culvert or pipe; and statement that the Contractor assumes all risk for damage.

1-07.8 High-Visibility Apparel

The Contractor shall require all personnel including service providers, subcontractors or material persons that are on foot in the work zone and are exposed to vehicle traffic or construction equipment to wear the high-visibility apparel described in this section.

The Contractor shall ensure that a competent person as identified in the MUTCD selects the appropriate high-visibility apparel suitable for the jobsite conditions.

High-visibility garments shall always be the outermost garments.

High-visibility garments shall be labeled as, and in a condition compliant with the ANSI/ISEA 107-2015 (or later version) and shall be used in accordance with manufacturer recommendations.

1-07.8(1) Traffic Control Personnel

All personnel performing the Work described in Section 1-10 (including traffic control supervisors, flaggers, and others performing traffic control labor of any kind) shall

comply with the following:

1. During daylight hours with clear visibility, workers shall wear a high-visibility ANSI/ISEA 107 Type R Class 2 or 3 vest or jacket, and hardhat meeting the high-visibility headwear requirements of WAC 296-155-305; and
2. During hours of darkness (½ hour before sunset to ½ hour after sunrise) or other low-visibility conditions (snow, fog, etc.), workers shall wear a high-visibility ANSI/ISEA 107 Type R Class 2 or 3 vest or jacket, high-visibility lower garment meeting ANSI/ISEA 107 Class E, and hardhat meeting the high-visibility headwear requirements of WAC 296-155-305.

1-07.8(2) Non-Traffic Control Personnel

All personnel, except those performing the Work described in Section 1-10, shall wear high-visibility apparel meeting the ANSI/ISEA 107 Type R Class 2 or 3 standard.

1-07.9 Wages

1-07.9(1) General

This Contract is subject to the minimum wage requirements of RCW 39.12 and to RCW 49.28 (as amended or supplemented). The hourly minimum rates for wages and fringe benefits are listed in the appendices of the Contract Provisions.

The Contractor, subcontractors, and all individuals or firms required by RCW 39.12, WAC 296-127, to pay minimum prevailing wages, shall not pay any worker less than the minimum hourly wage rates and fringe benefits required by RCW 39.12. Higher wages and benefits may be paid.

By including the hourly minimum rates for wages and fringe benefits in the Contract Provisions, the Contracting Agency does not imply that the Contractor will find labor available at those rates. The Contractor shall be responsible for amounts above the minimums that will have to be paid.

If employing labor in a class not listed in the Contract Provisions, the Contractor shall request a determination of the correct wage and benefits rate for that class and locality from the Industrial Statistician, Washington State Department of Labor and Industries (State L&I) and provide a copy of those determinations to the Engineer.

The Contractor shall ensure that all firms (all Suppliers, Manufacturers, or Fabricators) that fall under the provisions of RCW 39.12 because of the definition “Contractor” in WAC 296-127-010, complies with all the requirements of RCW 39.12.

The Contractor shall be responsible for compliance with the requirements of RCW 39.12 by all firms (all subcontractors, Suppliers, Manufacturers, or Fabricators) engaged in a part of the Work necessary to complete this Contract. Therefore, should a violation of this Subsection occur by any firm that is providing Work or materials for completion of this Contract whether directly or indirectly responsible to the Contractor, the Contracting Agency will take action against the Contractor, as provided by the provisions of the Contract, to achieve compliance, including but not limited to, withholding payment on the Contract until compliance is achieved.

In the event the Contracting Agency has an error (omissions are not errors) in the listing of the hourly minimum rates for wages and fringe benefits in the Contract Provisions,

the Contractor, subcontractors, or other firms that are required to pay prevailing wages, shall be required to pay the rates as determined to be correct by State L&I (or by the U.S. Department of Labor when that agency sets the rates). A change order will be prepared to ensure that this occurs. The Contracting Agency will reimburse the Contractor for the actual cost to pay the difference between the correct rates and the rates included in the Contract Provisions, subject to the following conditions:

1. The affected firm relied upon the rates included in the Contract Provisions to prepare its Bid and certifies that it did so;
2. The allowable amount of reimbursement will be the difference between the rates listed and rates later determined to be correct plus only appropriate payroll markup the employer must pay, such as, social security and other payments the employer must make to the Federal or State Government;
3. The allowable amount of reimbursement may also include some overhead cost, such as, the cost for bond, insurance, and making supplemental payrolls and new checks to the employees because of underpayment for previously performed Work; and
4. Profit will not be an allowable markup.

Firms that anticipated, when they prepared their Bids, paying a rate equal to, or higher than, the correct rate as finally determined will not be eligible for reimbursement.

There are many work-ready pre-apprentices who are currently looking for work in the highway construction trades all across the state of Washington. Contractors may have apprenticeship utilization commitments as part of their business practices and as part of their Contract. Contractors may be subject to hiring commitments such as Equal Employment Opportunity, union commitments, and apprenticeship utilization requirements on Contracts receiving Federal or State funds. As part of a Contractor's Good Faith Efforts, contacting the Office of Equal Opportunity's On the Job Training Support Services (OJT/SS) Program Coordinator is highly encouraged. The OJT/SS Program Coordinator can connect Contractors with Washington State Apprenticeship Training Council recognized Pre-Apprenticeship training providers throughout the state, who give training to individuals in highway construction trades. These training providers can identify work-ready individuals in the necessary trades. Contractors who have been awarded WSDOT Contracts should be prepared to discuss their recruitment plans and how coordination with the OJT/SS Program Coordinator will be incorporated into that effort if needed. The Contractor may contact the OJT/SS Program Coordinator at 360-704-6314, or by email at ojtssinfo@wsdot.wa.gov.

1-07.9(2) Posting Notices

Notices and posters shall be placed in areas readily accessible to read by employees. The Contractor shall ensure the most current edition of the following are posted:

1. WHD 1088 – **Employee Rights Under the Fair Labor Standards Act** published by US Department of Labor.
2. WHD 1420 – **Employee Rights and Responsibilities Under The Family And Medical Leave Act** published by US Department of Labor.
3. WHD 1462 – **Employee Polygraph Protection Act** published by US Department of Labor.

4. F416-081-909 – **Job Safety and Health Law** published by Washington State Department of Labor and Industries. Post on all projects.
5. F242-191-909 – **Notice To Employees** – post on all projects.
6. F700-074-000 – **Your Rights as a Worker in Washington State** by Washington State Department of Labor and Industries (L&I).
7. EMS 9874 – **Unemployment Benefits** published by Washington State Employment Security Department.
8. Post one copy of the approved "Statement of Intent to Pay Prevailing Wages" for the Contractor, each subcontractor, and other firms (Suppliers, Manufacturers, or Fabricators) that fall under the provisions of RCW 39.12 because of the definition of "Contractor" in WAC 296-127-010.
9. Post one copy of the prevailing wage rates for the project.

1-07.9(3) Apprentices

When employing apprentices, the Contractor shall supply a link or electronic copy of each approved Apprentice Program that shows the ratio of journey level to apprentice workers and the hourly wage rate steps for each craft on a project.

Apprentice workers employed for whom an apprenticeship agreement has been registered and approved with the state apprenticeship council must be paid prevailing hourly rate for an apprentice of that trade. Workers not registered shall be considered to be a fully qualified journey level worker and therefore paid at the prevailing hourly rate for journey level workers of that trade in accordance with Section 1-07.9(1).

1-07.9(4) Wage Disputes

If labor and management cannot agree in a dispute over the proper prevailing wage rates, the Contractor shall refer the matter to the Director of State L&I (or to the U.S. Secretary of Labor when that agency sets the rates). The Director's (or Secretary's) decision shall be final, conclusive, and binding on all parties.

1-07.9(5) Required Documents

1-07.9(5)A General

All Statements of Intent to Pay Prevailing Wages, Affidavits of Wages Paid and Certified Payrolls shall be submitted to the Engineer using the L&I online Prevailing Wage Intent & Affidavit (PWIA) system.

1-07.9(5)B Intents and Affidavit

The Contractor shall submit via the PWIA system the following documents provided by the Industrial Statistician of the Washington State Department of Labor and Industries (State L&I) for themselves and for each firm covered under RCW 39.12 that will or has provided Work and materials for the Contract:

1. The approved "Statement of Intent to Pay Prevailing Wages." The Contracting Agency will make no payment under this Contract for the Work performed until this statement has been approved by State L&I and reviewed by the Engineer.
2. The approved "Affidavit of Prevailing Wages Paid." The Contracting Agency will not grant Completion until all approved Affidavit of Wages paid for the Contractor and all

subcontractors have been received by the Engineer. The Contracting Agency will not release to the Contractor funds retained under RCW 60.28.011 until all of the "Affidavit of Prevailing Wages Paid" forms have been approved by State L&I and all of the approved forms have been submitted to the Engineer for every firm that worked on the Contract.

The Contractor is responsible paying all fees required by State L&I.

1-07.9(5)C Certified Payrolls

Certified payrolls are required to be submitted by the Contractor for themselves and all subcontractors. The payrolls shall be submitted weekly.

1-07.9(5)D Penalties for Noncompliance

The Contractor is advised, if payrolls or Affidavits of Prevailing Wages Paid are not supplied, any or all payments may be withheld until compliance is achieved. In addition, failure to provide Statement of Intents, Affidavit of Wages Paid, or payrolls may result in other sanctions as provided by State laws (RCW 39.12.050) and/or Federal regulations (29 CFR 5.12).

1-07.9(6) Audits

The Contracting Agency may inspect or audit the Contractor's wage and payroll records as provided in Section 1-09.12.

1-07.10 Worker's Benefits

The Contractor shall make all payments required for unemployment compensation under Title 50 RCW and for industrial insurance and medical aid required under Title 51 RCW. If payments required by Title 50 or Title 51 is not made when due, the Contracting Agency may retain such payments from money due the Contractor and pay the same into the appropriate fund. Such payment will be made only after giving the Contractor 15 days prior written notice of the Contracting Agency's intent to disburse the funds to the Washington State Department of Labor and Industries or Washington State Employment Security Department as applicable. The payment will be made upon expiration of the 15 calendar day period if no legal action has been commenced to resolve the validity of the claim. If legal action is instituted to determine the validity of the claim prior to the expiration of the 15-day period, the Contracting Agency will hold the funds until determination of the action or written settlement agreement of the appropriate parties.

For Work on or adjacent to water, the Contractor shall make the determination as to whether workers are to be covered under the Longshoremen's and Harbor Worker's Compensation Act administered by the U.S. Department of Labor, or the State Industrial Insurance coverage administered by the Washington State Department of Labor and Industries.

The Contractor shall include in the various items in the Bid Proposal all costs for payment of unemployment compensation and for providing either or both of the insurance coverages. The Contractor will not be entitled to additional payment for: (1) failure to include such costs, or (2) determinations made by the U.S. Department of Labor or the Washington State Department of Labor and Industries regarding the insurance coverage.

The Public Works Contract Division of the Washington State Department of Labor and Industries will provide the Contractor with applicable industrial insurance and medical aid classification and premium rates. After receipt of a *Revenue Release* from the Washington State Department of Revenue, the Contracting Agency will verify through the Department of Labor and Industries that the Contractor is current with respect to the payments of industrial insurance and medical aid premiums.

1-07.11 Requirements for Nondiscrimination

1-07.11(1) Regulatory Authorities

1-07.11(1)A General Application

Discrimination in all phases of contracted employment, contracting activities and training is prohibited by Title VI of the Civil Rights Act of 1964, Section 162(a) of the Federal-Aid Highway Act of 1973, Section 504 of the Rehabilitation Act of 1973, the Age Discrimination Act of 1975, the Justice System Improvement Act of 1979, the American with Disabilities Act of 1990, the Civil Rights Restoration Act of 1987, 49 CFR Part 21, RCW 49.60 and other related laws and statutes. The referenced legal citations establish the minimum requirements for affirmative action efforts and define the basic nondiscrimination provisions as required by this section of these *Standard Specifications*.

1-07.11(1)B Standard Title VI Statutory/Regulatory Authorities

References to the term “Acts and Regulations” within Section 1-07.11 will refer to the following:

1. Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d et seq., 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin);
2. 49 C.F.R. Part 21 (entitled Non-discrimination In Federally-Assisted Programs Of The Department Of Transportation-Effectuation Of Title VI of the Civil Rights Act Of 19640;
3. 28 C.F.R. section 50.3 (US Department of Justice Guidelines for Enforcement of Title VI of the Civil Rights Act of 1964).

1-07.11(1)C Nondiscrimination Authorities

During the performance of this Contract, the Contractor, for itself, its assignees, and successors in interest agrees to comply with the following nondiscrimination statues and authorities; including but not limited to:

1. Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d et seq., 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin) and C.F.R. Part 21.
2. The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 U.S.C §4601), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects).
3. Federal-Aid Highway Act of 1973, (23 U.S.C. § 324 et. seq.), as amended, (prohibits discrimination on the basis of sex).

4. Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. § 794 et seq.), as amended (prohibits discrimination on the basis of disability); and 49 C.F.R. Part 27.
5. The Age of Discrimination Act of 1975, as amended (42 U.S.C. § 6101 et seq.), (prohibits discrimination on the basis of age).
6. Airport and Airway Improvement Act of 1982, (49 U.S.C. § 471, Section 47123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex).
7. The Civil Rights Restoration Act of 1987, (PL 100-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, The Age of Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition and terms “programs or activities” to include all of the program or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not).
8. Titles II and III of the Americans with Disabilities Act, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. § 12131-12189) as implemented by Department of Transportation regulations at 49 C.F.R. parts 37 and 38.
9. The Federal Aviation Administration’s Nondiscrimination statute (49 U.S.C. § 47123), (prohibits discrimination on the basis of race, color national origin, and sex).
10. Executive Order 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures nondiscrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations.
11. Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to-ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100).
12. Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S.C. 1681 et seq.).

1-07.11(2) Contractual Requirements

1. The Contractor shall maintain a Work site that is free of harassment, humiliation, fear, hostility and intimidation at all times. Behaviors that violate this requirement include but are not limited to:
   a. Persistent conduct that is offensive and unwelcome.
   b. Conduct that is considered to be hazing.
   c. Jokes about race, gender, or sexuality that are offensive.
   d. Unwelcome, unwanted, rude or offensive conduct or advances of a sexual nature which interferes with a person’s ability to perform their job or creates an

intimidating, hostile, or offensive work environment.

e. Language or conduct that is offensive, threatening, intimidating or hostile based on race, gender, or sexual orientation.

f. Repeating rumors about individuals in the Work Site that are considered to be harassing or harmful to the individual's reputation.

2. The Contractor shall not discriminate against any employee or applicant for contracted employment because of race, religion, color, national origin, sex, age, marital status, or the presence of any physical, sensory or mental disability.

3. The Contractor shall, in all solicitations or advertisements for employees, state that all qualified applicants will be considered for employment, without regard to race, religion, color, national origin, sex, age, marital status, or the presence of any physical, sensory, or mental disability.

4. The Contractor shall insert the following notification in all solicitations for bids for Work or material subject to the Acts and Regulations and made in connection with all FHWA programs and, in adapted form in all proposals for negotiated agreements regardless of funding source:

   The Contractor in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 U.S. C § 2000d to 2000d-4) and the Regulations, hereby notifies all bidders that it will affirmatively ensure that in any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award.

5. The Contractor shall make decisions with regard to selection and retention of subcontractors, procurement of materials and equipment and similar actions related to the Contract without regard to race, religion, color, national origin, sex, age, marital status, or the presence of any physical, sensory, or mental disability.

6. The Contractor shall send to each labor union, employment agency, or representative of workers with which the Contractor has a collective bargaining agreement or other contract or understanding, a notice advising the labor union, employment agency or worker's representative, of the Contractor's commitments under this Contract with regard to nondiscrimination.

7. The Contractor shall permit access to its books, records and accounts by the Contracting Agency for the purpose of investigating to ascertain compliance with these Specifications. In the event that information required of a Contractor is in the possession of another who fails or refuses to furnish this information, the Contractor shall describe, in writing, what efforts were made to obtain the information.

8. The Contractor shall maintain records with the name and address of each minority/female worker referred to the Contractor and what action was taken with respect to the referred worker.

9. The Contractor shall notify the Contracting Agency whenever the union with which the Contractor has a collective bargaining agreement has impeded the Contractor's efforts to effect minority/female workforce utilization. This being the case, the

Contractor shall show what relief they have sought under such collective bargaining agreements.

10. The Contractor is encouraged to participate in Contracting Agency and Washington State Human Rights Commission approved program(s) designed to train craft-workers for the construction trades.

1-07.11(2)A Equal Employment Opportunity (EEO) Responsibilities

Title VI Responsibilities

During the performance of this Contract, the Contractor, for itself, its assignees and successors in interest (hereinafter referred to as the "Contractor") agrees as follows:

1. **Compliance With Regulations** – The Contractor (hereinafter includes consultants) shall comply with the Regulations relative to nondiscrimination in federally assisted programs of the U.S. Department of Transportation (hereinafter DOT), Federal Highway Administration (FHWA), as they may be amended from time to time, (hereinafter referred to as the Regulations), which are herein incorporated by reference and made a part of this Contract.
2. **Nondiscrimination** – The Contractor, with regard to the Work performed by it during the Contract, shall not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The Contractor shall not participate directly or indirectly in the discrimination prohibited by Acts and Regulations, including employment practices when the Contract covers any activity, project or program set forth in Appendix B of 49 CFR Part 21.
3. **Solicitations for Subcontracts, Including Procurement of Materials and Equipment** – In all solicitations either by competitive bidding or negotiations made by the Contractor for Work to be performed under a subcontract, including procurement of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the Contractor of the Contractor's obligations under this Contract and the Acts and Regulations relative to nondiscrimination on the ground of race, color, or national origin.
4. **Information and Reports** – The Contractor shall provide all information and reports required by the Acts and Regulations or directives issued pursuant thereto, and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Washington State Department of Transportation or the Federal Highway Administration to be pertinent to ascertain compliance with such Acts, Regulations and instructions. Where any information required of a Contractor is in the exclusive possession of another who fails or refuses to furnish this information, the Contractor shall so certify to the Washington State Department of Transportation, or the Federal Highway Administration as appropriate, and shall set forth what efforts it has made to obtain the information.
5. **Sanctions for Noncompliance** – In the event of the Contractor's noncompliance with the nondiscrimination provisions of this Contract, the Washington State Department of Transportation shall impose such Contract sanctions as it or the Federal Highway Administration may determine to be appropriate, including, but not limited to:

a. Withholding of payments to the Contractor under the Contract until the Contractor complies, and/or;

b. Cancellation, termination, or suspension of the Contract, in whole or in part.

6. **Incorporation of Provisions** – The Contractor shall include the provisions of paragraphs (1) through (6) in every subcontract, including procurement of materials and leases of equipment, unless exempt by the Acts and Regulations, or directives issued pursuant thereto. The Contractor shall take such action with respect to any subcontractor or procurement as the Washington State Department of Transportation or the Federal Highway Administration may direct as a means of enforcing such provisions including sanctions for noncompliance.

   Provided, that if the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier because of such direction, the Contractor may request the Washington State Department of Transportation to enter into any litigation to protect the interests of the Washington State Department of Transportation. In addition, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

1-07.11(3) Equal Employment Opportunity Officer

The Contractor shall officially designate and make known to the Engineer during the preconstruction conference and discussions the firm's Equal Employment Opportunity Officer (hereinafter referred to as the EEO Officer). The EEO Officer will also be responsible for making him/herself known to each of the Contractor's employees. The EEO Officer must possess the responsibility, authority, and capability for administering and promoting an active and effective Contractor program of equal employment opportunity.

1-07.11(4) Dissemination of Policy

1-07.11(4)A Supervisory Personnel

All members of the Contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, shall be made fully cognizant of, and shall implement the Contractor's equal employment opportunity policy and contractual responsibilities to provide equal employment opportunity in each grade and classification of employment. To ensure that the above agreement will be met, the following actions shall be taken as a minimum:

1. **EEO Meetings** – Periodic meetings of supervisory and personnel office employees shall be conducted before the start of Work and then not less often than once every 6 months, at which time the Contractor's equal employment opportunity policy and its implementation shall be reviewed and explained. The meetings shall be conducted by the EEO Officer or other knowledgeable company official.
2. **EEO Indoctrination** – All new supervisory or personnel office employees shall be given a thorough indoctrination by the EEO Officer or other knowledgeable company official covering all major aspects of the Contractor's equal employment opportunity obligations within 30 days following their reporting for duty with the Contractor.
3. **Internal EEO Procedures** – All personnel who are engaged in direct recruitment for

the project shall be instructed by the EEO Officer or appropriate company official in the Contractor's procedures for locating and hiring minority group and female employees.

1-07.11(4)B Employees, Applicants, and Potential Employees

In order to make the Contractor's equal employment opportunity policy known to all employees, prospective employees, and potential sources of employees, e.g., schools, employment agencies, labor unions (where appropriate), college placement officers, and community organizations, the Contractor shall take the following actions:

1. **Notices and Posters** – Notices and posters setting forth the Contractor's equal employment opportunity policy shall be placed in areas readily accessible to employees, applicants for employment, and potential employees.
2. **EEO Indoctrination** – The Contractor's equal employment opportunity policy and the procedures to implement such policy shall be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

1-07.11(5) Sanctions

In the event of the Contractor is found in noncompliance with the provisions of Section 1-07.11, the Contracting Agency may impose such Contract sanctions as it or the Federal Highway Administration may determine necessary to gain compliance including, but not limited to:

1. Progress payment requests may not be honored until the noncompliance is remedied to the satisfaction of the Contracting Agency.
2. The Contract may be suspended, in whole or in part, until such time as the Contractor is determined to be in compliance by the Contracting Agency.
3. The Contractor's pre-qualification may be suspended or revoked pursuant to WAC 468-16. The Contracting Agency may refer the matter to the Federal Highway Administration (FHWA) for possible federal sanctions.
4. The Contract may be terminated.

Immediately upon the Engineer's request, the Contractor shall remove from the Work site any employee engaging in behaviors that promote harassment, humiliation, fear or intimidation including but not limited to those described in these specifications.

1-07.11(6) Incorporation of Provisions

The Contractor shall include the provisions of Section 1-07.11(1)A through C, Section 1-07.11(2), Section 1-07.11(2)A and the Section 1-07.11(5) Sanctions in every subcontract including procurement of materials and leases of equipment. The Contractor shall take such action or enforce sanctions with respect to a subcontractor or supplier as the Contracting Agency may direct as a means of enforcing such provisions. In the event a Contractor becomes involved in litigation with a subcontractor or supplier as a result of such direction, the Contractor may request the Contracting Agency enter into such litigation to protect their interests.

1-07.11(7) Vacant

1-07.11(8) Vacant

1-07.11(9) Subcontracting, Procurement of Materials, and Leasing of Equipment

Nondiscrimination – The Contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age, or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment.

Solicitation and Utilization – The Contractor shall use their best effort to solicit bids from, and to utilize, disadvantaged, minority, and women subcontractors, or subcontractors with meaningful minority and women representation among their employees.

Subcontractor EEO Obligations – The Contractor shall notify all potential Subcontractors and suppliers of the EEO obligations required by the Contract. The Contractor shall use their efforts to ensure subcontractor's compliance with their equal employment opportunity obligations.

1-07.11(10) Records and Reports

1-07.11(10)A General

The Contractor shall keep such records as are necessary to determine compliance with the Contractor's equal employment opportunity obligations. The records kept by the Contractor shall be designated to indicate:

1. **Work Force Data** – The number of minority and nonminority group members and women employed in each work classification on the project.
2. **Good Faith Efforts – Unions** – The progress and efforts being made in cooperation with unions to increase employment opportunities for minorities and women (applicable only to contractors who rely in whole or in part on unions as a source of their work force).
3. **Good Faith Efforts – Recruitment** – The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minority and female employees.
4. **Subcontracting** – The progress and efforts being made in securing the services of disadvantaged, minority, and women subcontractors or subcontractors with meaningful minority and female representation among their employees.

1-07.11(10)B Required Records and Retention

All records must be retained by the Contractor for a period of three years following acceptance of the Contract Work. All records shall be available at reasonable times and places for inspection by authorized representatives of either the Contracting Agency or the Washington State Department of Transportation.

1-07.13 Contractor's Responsibility for Work

1-07.13(1) General

All Work and material for the Contract, including change order Work, shall be at the sole risk of the Contractor until the entire improvement has been completed as determined by the Engineer, except as provided in this section.

The Contractor shall rebuild, repair, restore, and make good all damages to the permanent or temporary Work occurring before the Physical Completion Date and shall bear all the expense to do so, except damage to the permanent Work caused by: (a) acts of God, such as earthquake, floods, or other cataclysmic phenomenon of nature, or (b) acts of the public enemy or of governmental authorities; or (c) slides in cases where Section 2-03.3(11) is applicable; Provided, however, that these exceptions shall not apply should damages result from the Contractor's failure to take reasonable precautions or to exercise sound engineering and construction practices in conducting the Work.

If the performance of the Work is delayed as a result of damage by others, an extension of time will be evaluated in accordance with Section 1-08.8.

Nothing contained in this section shall be construed as relieving the Contractor of responsibility for, or damage resulting from, the Contractor's operations or negligence, nor shall the Contractor be relieved from full responsibility for making good defective Work or materials as provided for under Section 1-05.

1-07.13(2) Relief of Responsibility for Completed Work

Upon written request, the Contractor may be relieved of the duty of maintaining and protecting certain portions of the Work, as described below, which have been completed in all respects in accordance with the requirements of the Contract. If the Engineer provides written approval, the Contractor will be relieved of the responsibility for damage to said completed portions of the Work resulting from use by public traffic or from the action of the elements or from any other cause, but not from damage resulting from the Contractor's operations or negligence.

Portions of the Work for which the Contractor may be relieved of the duty of maintenance and protection as provided in the above paragraph include but are not limited to the following:

1. The completion of ¼ mile of Roadway or ¼ mile of one Roadway of a divided Highway or a frontage road including the Traveled Way, Shoulders, drainage control facilities, planned Roadway protection Work, lighting, and traffic control and access facilities.
2. A bridge or other Structure of major importance.
3. A complete unit of a traffic control signal system or of a Highway lighting system.
4. A complete unit of permanent Highway protection Work.
5. A building that is functionally complete and open to the public.
6. A Contract Proposal item.

1-07.14 Responsibility for Damage

The Contracting Agency and all officers and employees of the County will not be responsible in any manner: for losses or damage that may happen to the Work or any part; for losses of material or damage to any of the materials or other things used or employed in the performance of Work; for injury to or death of either workers or the public; or for damage to the public for causes which might have been prevented by the Contractor, or the workers, or anyone employed by the Contractor.

The Contractor shall be responsible for all liability imposed by law for injuries to, or the death of, any persons or damages to property resulting from any cause whatsoever during the performance of the Work, or before final acceptance.

Subject to the limitations in this section, and RCW 4.24.115, the Contractor shall indemnify, defend, and save harmless the Contracting Agency and all officers and employees of the County from all claims, suits, or actions brought for injuries to, or death of, any persons or damages resulting from construction of the Work or in consequence of any negligence or breach of Contract regarding the Work, the use of improper materials in the Work, caused in whole or in part by an act or omission by the Contractor or the agents or employees of the Contractor during performance or at any time before final acceptance. In addition to a remedy authorized by law, the Contracting Agency may retain so much of the money due the Contractor as deemed necessary by the Engineer to ensure the defense and indemnification obligations of this section until disposition has been made of such suits or claims.

Pursuant to RCW 4.24.115, if such claims, suits, or actions result from the concurrent negligence of (a) the indemnitee or the indemnitee's agents or employees and (b) the Contractor or the Contractor's agent or employees, the indemnity provisions provided in the preceding paragraphs of this section shall be valid and enforceable only to the extent of the Contractor's negligence or the negligence of its agents and employees.

The Contractor shall bear sole responsibility for damage to completed portions of the project and to property located off the project caused by erosion, siltation, runoff, or other related items during the construction of the project. The Contractor shall also bear sole responsibility for any pollution of rivers, streams, ground water, or other waters that may occur as a result of construction operations.

The Contractor shall exercise all necessary precautions throughout the life of the Project to prevent pollution, erosion, siltation, and damage to property.

The Contracting Agency will forward to the Contractor all claims filed against the State according to RCW 4.92.100 that are deemed to have arisen in relation to the Contractor's Work or activities under this Contract, and, in the opinion of the Contracting Agency, are subject to the defense, indemnity, and insurance provisions of these Special Provisions. Claims will be deemed tendered to the Contractor and insurer, who has named the State as a named insured or an additional insured under the Contract's insurance provisions, once the claim has been forwarded via email with delivery confirmation to the Contractor. The Contractor shall be responsible to provide a copy of the claim to the Contractor's designated insurance agent who has obtained/met the Contract's insurance provision requirements.

Within 60 calendar days following the date a claim is sent by the Contracting Agency to the Contractor, the Contractor shall notify both the Claimant as specified on the Claimant's contact information and the Contracting Agency by responding to the tendering email:

a. Whether the claim is allowed or is denied in whole or in part, and, if so, the specific reasons for the denial of the individual claim, and if not denied in full, when payment has been or will be made to the claimant(s) for the portion of the claim that is allowed, or

b. If resolution negotiations are continuing. In this event, status updates will be reported no longer than every 60 calendar days until the claim is resolved or a lawsuit is filed.

If the Contractor fails to provide the above notification within 60 calendar days, then the Contractor shall yield to the Contracting Agency sole and exclusive discretion to allow all or part of the claim on behalf of the Contractor, and the **Contractor shall be deemed to have WAIVED any and all defenses, objections, or other avoidances to the Contracting Agency's allowance of the claim, or the amount allowed by the Contracting Agency**, under common law, constitution, statute, or the Contract and these Special Provisions. If all or part of a claim is allowed, the Contracting Agency will notify the Contractor via email with delivery confirmation that it has allowed all or part of the claim and make appropriate payments to the claimant(s) with State funds.

Payments of County funds by the Contracting Agency to claimant(s) under this section will be made on behalf of the Contractor and at the expense of the Contractor, and the Contractor shall be unconditionally obligated to reimburse the Contracting Agency for the "total reimbursement amount", which is the sum of the amount paid to the claimant(s), plus all costs incurred by the Contracting Agency in evaluating the circumstances surrounding the claim, the allowance of the claim, the amount due to the claimant, and all other direct costs for the Contracting Agency's administration and payment of the claim on the Contractor's behalf. The Contracting Agency will be authorized to withhold the total reimbursement amount from amounts due the Contractor, or, if no further payments are to be made to the Contractor under the Contract, the Contractor shall directly reimburse the Contracting Agency for the amounts paid within 30 days of the date notice that the claim was allowed was sent to the Contractor. In the event reimbursement from the Contractor is not received by the Contracting Agency within 30 days, interest shall accrue on the total reimbursement amount owing at the rate of 12 percent per annum calculated at a daily rate from the date the Contractor was notified that the claim was allowed. The Contracting Agency's costs to enforce recovery of these amounts are additive to the amounts owing.

The Contractor specifically assumes all potential liability for actions brought by employees of the Contractor and, solely for the purpose of enforcing the defense and indemnification obligations set forth in Section 1-07.14, the Contractor specifically waives immunity granted under the State industrial insurance law, Title 51 RCW. This waiver has been mutually negotiated by the parties. The Contractor shall similarly require that each subcontractor it retains in connection with the project comply with the terms of this paragraph, waive any immunity granted under Title 51 RCW, and assume all liability for actions brought by employees of the subcontractor.

1-07.15 Temporary Water Pollution Prevention

1-07.15(1) Spill Prevention, Control, and Countermeasures Plan

The Contractor shall prepare a Type 2 Working Drawing consisting of a project-specific spill prevention, control, and countermeasures plan (SPCC Plan), and shall implement the plan for the duration of the project. No on-site construction activities may commence until the Contracting Agency accepts an SPCC Plan for the project. An SPCC Plan template and guidance information is available at https://wsdot.wa.gov/engineering-standards/environmental-guidance/stormwater-water-quality.

The SPCC Plan shall address all fuels, petroleum products, hazardous materials, and other materials defined in Chapter 447 of the WSDOT Environmental Manual M 31-11. Occupational safety and health requirements that may pertain to SPCC Plan implementation are contained in, but not limited to, WAC 296-824 and WAC 296-843. The SPCC Plan shall address conditions that may be required by Section 3406 of the current International Fire Code, or as approved by the local Fire Marshal.

Implementation Requirements

The Contractor shall update the SPCC Plan throughout project construction so that the written plan reflects actual site conditions and practices. The Contractor shall update the SPCC Plan at least annually and maintain a copy of the updated SPCC Plan on the project site. The Contractor shall fully implement the SPCC Plan, as accepted and updated, at all times.

SPCC Plan Element Requirements

The SPCC Plan shall set forth the following information in the following order:

1. **Responsible Personnel** – Identify the names, titles, and contact information for the personnel responsible for implementing and updating the plan and for responding to spills.
2. **Spill Reporting –** List the names and telephone numbers of the Federal, State, and local agencies the Contractor shall notify in the event of a spill.
3. **Project and Site Information** – Describe the following items:
   a. The project Work.
   b. The site location and boundaries.
   c. The drainage pathways from the site.
   d. Nearby waterways and sensitive areas and their distances from the site.
4. **Potential Spill Sources** – Describe each of the following for all potentially hazardous materials brought or generated on-site including but not limited to materials used for equipment operation, refueling, maintenance, or cleaning:
   a. Name of material and its intended use.
   b. Estimated maximum amount on-site at any one time.
   c. Location(s) (including any equipment used below the ordinary high water line) where the material will be staged, used, and stored and the distance(s) from nearby waterways and sensitive areas.

5. **Preexisting Contamination** – Describe any preexisting contamination and contaminant sources (such as buried pipes or tanks) in the project area that are described in the Contract provisions and Plans. Identify equipment and Work practices that shall be used to prevent the release of contamination.
6. **Spill Prevention and Response Training** – Describe how and when all project personnel, including refueling personnel and other subcontractors, shall be trained in spill prevention, containment, and response and in the location of spill response kits.
7. **Spill Prevention** – Describe the following items:
    a. The contents and locations of spill response kits that the Contractor shall supply and maintain that are appropriately stocked, located in close proximity to hazardous materials and equipment, and immediately accessible.
    b. Security measures for potential spill sources to prevent accidental spills and vandalism.
    c. Methods used to prevent stormwater from contacting hazardous materials.
    d. Secondary containment for each potential spill source listed in 4, above. Secondary containment structures shall be in accordance with Section S9.D.9 of Ecology's Construction Stormwater General NPDES Permit, where secondary containment means placing tanks or containers within an impervious structure capable of containing 110 percent of the volume contained in the largest tank within the containment structure. Double-walled tanks do not require additional secondary containment.
    e. BMP methods and locations where they are used to prevent discharges to ground or water during mixing and transfer of hazardous materials and fuel. Methods to control pollutants shall use BMPs in accordance with Ecology's Construction Stormwater General NPDES Permit. BMP guidance is provided in Ecology's Stormwater Management Manuals, such as Volume II – Construction Stormwater Pollution Prevention, BMP C153, and Volume IV – Source Control BMPs.
    f. Refueling procedures for equipment that cannot be moved from below the ordinary high water line.
    g. Daily inspection and cleanup procedures that ensure all equipment used below the ordinary high water line is free of all external petroleum-based products.
    h. Routine equipment, storage area, and structure inspection and maintenance practices to prevent drips, leaks, or failures of hoses, valves, fittings, containers, pumps, or other systems that contain or transfer hazardous materials.
    i. Site inspection procedures and frequency.
8. **Spill Response** – Outline the response procedures the Contractor shall follow for each scenario listed below, indicating that if hazardous materials are encountered or spilled during construction, the Contractor shall do everything possible to control and contain the material until appropriate measures can be taken. Include a description of the actions the Contractor shall take and the specific on-site spill response equipment that shall be used to assess the spill, secure the area, contain and eliminate the spill source, clean up spilled material, decontaminate equipment, and dispose of spilled and contaminated material:

a. A spill of each type of hazardous material at each location identified in 4, above.
b. Stormwater that has come into contact with hazardous materials.
c. A release or spill of any preexisting contamination and contaminant source described in 5, above.
d. A release or spill of any unknown preexisting contamination and contaminant sources (such as buried pipes or tanks) encountered during project Work.
e. A spill occurring during Work with equipment used below the ordinary high water line.

If the Contractor will use a subcontractor for spill response, provide contact information for the subcontractor under item 1 (above), identify when the subcontractor shall be used, and describe actions the Contractor shall take while waiting for the subcontractor to respond.

9. **Project Site Map** – Provide a map showing the following items:
   a. Site location and boundaries.
   b. Site access roads.
   c. Drainage pathways from the site.
   d. Nearby waterways and sensitive areas.
   e. Hazardous materials, equipment, and decontamination areas identified in 4, above.
   f. Preexisting contamination or contaminant sources described in 5, above.
   g. Spill prevention and response equipment described in 7 and 8, above.
10. **Spill Report Forms** – Provide a copy of the spill report form(s) that the Contractor shall use in the event of a release or spill.

Payment

Payment is included in the Bid Item “Mobilization.”

1-07.16 Protection and Restoration of Property

1-07.16(1) Private/Public Property

1-07.16(1)A General

The Contractor shall protect private or public property on or in the vicinity of the Work site. The Contractor shall ensure that it is not removed, damaged, destroyed, or prevented from being used unless the Contract so specifies.

Property includes land, utilities, trees, landscaping, improvements legally on the right of way, markers, monuments, buildings, Structures, pipe, conduit, sewer or water lines, signs, and other property of all description whether shown on the Plans or not.

If the Engineer orders, or if otherwise necessary, the Contractor shall install protection, acceptable to the Engineer, for property such as that listed in the previous paragraph. The Contractor is responsible for locating and protecting all property that is subject to damage by the construction operation.

If the Contractor (or agents/employees of the Contractor) damage, destroy, or interfere

with the use of such property, the Contractor shall restore it to original condition. The Contractor shall also halt all interference with the property's use. If the Contractor refuses or does not respond immediately, the Engineer may have such property restored by other means and subtract the cost from money that will be or is due the Contractor.

1-07.16(1)B Contracting Agency Property

The Contractor shall not use Contracting Agency owned or controlled property other than that directly affected by the Contract Work without the approval of the Engineer. If the Engineer grants such approval, the Contractor shall then vacate the area when ordered to do so by the Engineer. Approval to temporarily use the property shall not create entitlement to further use or to compensation for conditions or requirements imposed.

1-07.16(2) Vegetation Protection and Restoration

Existing trees and other vegetation, where shown in the Plans or designated by the Engineer, shall be saved and protected through the life of the Contract. The Engineer will designate the vegetation to be saved and protected by a site preservation line, high visibility fencing, or individual flagging.

Damage which may require replacement of vegetation includes torn bark stripping, broken branches, exposed root systems, cut root systems, poisoned root systems, compaction of surface soil and roots, puncture wounds, drastic reduction of surface roots or leaf canopy, changes in grade greater than 6 inches, or other changes to the location that may jeopardize the survival or health of the vegetation to be preserved.

When large roots of trees designated to be saved are exposed by the Contractor's operation, they shall be wrapped with heavy, moist material, such as burlap or canvas, for protection and to prevent excessive drying. The material shall be kept moist and securely fastened until the roots are covered to finish grade. All material and fastening material shall be removed from the roots before covering. All roots 1 inch or larger in diameter, that are damaged, shall be pruned with a sharp saw or pruning shear. Damaged, torn, or ripped bark shall be removed as ordered by the Engineer at no additional cost to the Contracting Agency.

Pruning activity required to complete the Work as specified shall be performed by a Certified Arborist at the direction of the Engineer.

If due to, or for reasons related to the Contractor's operation, trees, shrubs, ground cover or herbaceous vegetation designated to be saved is destroyed, disfigured, or damaged to the extent that continued life is questionable as determined by the Engineer, it shall be removed by the Contractor at the direction of the Engineer.

The Contractor will be assessed damages equal to triple the value of the vegetation as determined in the *Guide for Plant Appraisal*, Current Edition, published by the International Society of Arboriculture or the estimated cost of restoration with a similar species. Shrub, ground cover, and herbaceous plant values will be determined using the Cost of Cure Method. Damage so assessed will be deducted from the monies due or that may become due the Contractor.

1-07.16(2)A Wetland and Sensitive Area Protection

Existing wetland and other sensitive areas, where shown in the Plans or designated by the Engineer, shall be saved and protected through the life of the Contract. When applicable, a site preservation line has been established as a boundary between work zones and sensitive environmental areas.

The Contractor shall install high visibility fence as shown in the Plans or designated by the Engineer in accordance with Section 8-01.3(1). The areas to be protected include critical environmental areas, buffer zones, and other areas of vegetation to be preserved. The Contractor shall keep areas identified by the site preservation lines free of construction equipment, construction materials, debris, and runoff. No access, including, but not limited to, excavation, clearing, staging, or stockpiling, shall be performed inside the protected area.

1-07.16(4) Archaeological and Historical Objects

Archaeological or historical objects, such as ruins, sites, buildings, artifacts, fossils, or other objects of antiquity that may have significance from a historical or scientific standpoint, which may be encountered by the Contractor, shall not be further disturbed. The Contractor shall immediately notify the Engineer of any such finds.

The Engineer will determine if the material is to be salvaged. The Contractor may be required to stop Work in the vicinity of the discovery until such determination is made. The Engineer may require the Contractor to suspend Work in the vicinity of the discovery until salvage is accomplished.

If the Engineer finds that the suspension of Work in the vicinity of the discovery increases or decreases the cost or time required for performance of any part of the Work under this Contract, the Engineer will make an adjustment in payment or the time required for the performance of the Work in accordance with Sections 1-04.4 and 1-08.8.

1-07.16(4)A Inadvertent Discovery of Human Skeletal Remains

If human skeletal remains are encountered by the Contractor, they shall not be further disturbed. The Contractor shall immediately notify the Engineer of any such finds, and shall cease all work adjacent to the discovery, in an area adequate to provide for the total security and protection of the integrity of the skeletal remains. The Engineer may require the Contractor to suspend Work in the vicinity of the discovery until final determinations are made and removal of the skeletal remains is completed.

If the Engineer finds that the suspension of Work in the vicinity of the discovery increases or decreases the cost or time required for performance of any part of the Work under this Contract, the Engineer will make an adjustment in payment or the time required for the performance of the Work in accordance with Sections 1-04.4 and 1-08.8.

1-07.16(5) Wells

1-07.16(5)A Protection of Wells

The Contractor shall save and protect existing wells throughout the life of the Contract at the locations as shown in the Plans. For the definition of well types see

WAC 173-160-111 and WAC 173-160-410.

The existing wells shall not be disturbed during any construction activity.

1-07.16(5)B Discovery of Unidentified Wells

If unidentified wells are encountered by the Contractor, they shall not be further disturbed. The Contractor shall ensure unidentified wells encountered are protected from all construction activities including spills. The Contractor shall follow the procedures set forth in Section 1-04.7. The Engineer will determine if the well will be protected in accordance with Section 1-07.1, Section 1-07.5(3), and Section 1-07.16, or the well will be decommissioned as part of the Work.

1-07.16(6) Payment

All costs to comply with this section and for the protection and repair specified in this section, unless otherwise stated, are incidental to the Contract and are the responsibility of the Contractor. The Contractor shall include all related costs in the unit Bid prices of the Contract.

1-07.17 Utilities and Similar Facilities

The Contractor shall protect all private and public utilities from damage resulting from the Work. Among others, these utilities include: telephone, telegraph, and power lines; pipelines, sewer and water lines; railroad tracks and equipment; and highway lighting and signing systems, and intelligent transportation systems (ITS). All costs required to protect public and private utilities shall be at the Contractor's expense, except as provided otherwise in this section.

RCW 19.122 relates to underground utilities. In accordance with this RCW, the Contractor shall call the One-Number Locator Service for field location of utilities. If no locator service is available for the area, notice shall be provided individually to those owners of utilities known to, or suspected of, having underground facilities within the area of the proposed excavation.

Locations and dimensions shown in the Plans for existing facilities are in accordance with available information obtained without uncovering, measuring, or other verification.

The following addresses and telephone numbers of utility companies known or suspected of having facilities within or adjacent to the project limits are supplied for the Contractor's convenience:

Cascade Natural Gas
P.O. Box 539
Bremerton, WA 98337
Contact: Shawn O'Neill
Telephone: 360-405-4225

Lumen
611 – 6th Street
Bremerton, WA 98337
Contact: Chris Jensen
Telephone: 360-535-0095

Puget Sound Energy
6522 Kitsap Way
Bremerton, WA 98312
Contact: Errol Burgos
Telephone: 425-324-5341

Comcast
4519 SE Mile Hill Drive
Port Orchard, WA 98366
Contact: Matthew Orosz
Telephone: 360-340-4989

Kitsap PUD
1431 NW Fill Hill Rd
Poulsbo, WA 98370
Contact: Jim LeCompte or Mike Flaherty
Telephone: 360-710-5771, 360-620-1259

1-07.18 Insurance

1-07.18(1) General Requirements

A. The Contractor shall procure and maintain the insurance described in all subsections of section 1-07.18 of these Special Provisions, from insurers with a current A. M. Best rating of not less than A-: VII and licensed to do business in the State of Washington. The Contracting Agency reserves the right to approve or reject the insurance provided, based on the insurer's financial condition.

B. The Contractor shall keep this insurance in force without interruption from the commencement of the Contractor's Work through the term of the Contract and for thirty (30) days after the Physical Completion date, unless otherwise indicated below.

C. If any insurance policy is written on a claims made form, its retroactive date, and that of all subsequent renewals, shall be no later than the effective date of this Contract. The policy shall state that coverage is claims made, and state the retroactive date. Claims-made form coverage shall be maintained by the Contractor for a minimum of 36 months following the Completion Date or earlier termination of this Contract, and the Contractor shall annually provide the Contracting Agency with proof of renewal. If renewal of the claims made form of coverage becomes unavailable, or economically prohibitive, the Contractor shall purchase an extended reporting period ("tail") or execute another form of guarantee acceptable to the Contracting Agency to assure financial responsibility for liability for services performed.

D. The Contractor's Automobile Liability, Commercial General Liability and Excess or Umbrella Liability insurance policies shall be primary and non-contributory insurance as respects the Contracting Agency's insurance, self-insurance, or self-insured pool coverage. Any insurance, self-insurance, or self-insured pool coverage maintained

by the Contracting Agency shall be excess of the Contractor's insurance and shall not contribute with it.

E. Contractor shall provide the Contracting Agency and all additional insureds with written notice of any policy cancellation, within two business days of their receipt of such notice.

F. The Contractor shall not begin work under the Contract until the required insurance has been obtained and approved by the Contracting Agency

G. Failure on the part of the Contractor to maintain the insurance as required shall constitute a material breach of contract, upon which the Contracting Agency may, after giving five business days' notice to the Contractor to correct the breach, immediately terminate the Contract or, at its discretion, procure or renew such insurance and pay any and all premiums in connection therewith, with any sums so expended to be repaid to the Contracting Agency on demand, or at the sole discretion of the Contracting Agency, offset against funds due the Contractor from the Contracting Agency.

H. All costs for insurance shall be incidental to and included in the unit or lump sum prices of the Contract and no additional payment will be made.

1-07.18(2) Additional Insured

All insurance policies, with the exception of Workers Compensation, and of Professional Liability and Builder's Risk (if required by this Contract) shall name the following listed entities as additional insured(s) using the forms or endorsements required herein:

- the Contracting Agency and its officers, elected officials, employees, agents, and volunteers

The above-listed entities shall be additional insured(s) for the full available limits of liability maintained by the Contractor, irrespective of whether such limits maintained by the Contractor are greater than those required by this Contract, and irrespective of whether the Certificate of Insurance provided by the Contractor pursuant to 1-07.18(4) describes limits lower than those maintained by the Contractor.

For Commercial General Liability insurance coverage, the required additional insured endorsements shall be at least as broad as ISO forms CG 20 10 10 01 for ongoing operations and CG 20 37 10 01 for completed operations.

1-07.18(3) Subcontractors

The Contractor shall cause each Subcontractor of every tier to provide insurance coverage that complies with all applicable requirements of the Contractor-provided insurance as set forth herein, except the Contractor shall have sole responsibility for determining the limits of coverage required to be obtained by Subcontractors.

The Contractor shall ensure that all Subcontractors of every tier add all entities listed in 1-07.18(2) as additional insureds, and provide proof of such on the policies as required by that section as detailed in 1-07.18(2) using an endorsement as least as broad as ISO CG 20 10 10 01 for ongoing operations and CG 20 37 10 01 for completed operations.

Upon request by the Contracting Agency, the Contractor shall forward to the Contracting Agency evidence of insurance and copies of the additional insured endorsements of each Subcontractor of every tier as required in 1-07.18(4) Verification of Coverage.

1-07.18(4) Verification of Coverage

The Contractor shall deliver to the Contracting Agency a Certificate(s) of Insurance and endorsements for each policy of insurance meeting the requirements set forth herein when the Contractor delivers the signed Contract for the work. Failure of Contracting Agency to demand such verification of coverage with these insurance requirements or failure of Contracting Agency to identify a deficiency from the insurance documentation provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

Verification of coverage shall include:

1. An ACORD certificate or a form determined by the Contracting Agency to be equivalent.
2. Copies of all endorsements naming Contracting Agency and all other entities listed in 1-07.18(2) as additional insured(s), showing the policy number. The Contractor may submit a copy of any blanket additional insured clause from its policies instead of a separate endorsement.
3. Any other amendatory endorsements to show the coverage required herein.
4. A notation of coverage enhancements on the Certificate of Insurance shall <u>not</u> satisfy these requirements – actual endorsements must be submitted.

Upon request by the Contracting Agency, the Contractor shall forward to the Contracting Agency a full and certified copy of the insurance policy(s). If Builders Risk insurance is required on this Project, a full and certified copy of that policy is required when the Contractor delivers the signed Contract for the work.

1-07.18(5) Coverages and Limits

The insurance shall provide the minimum coverages and limits set forth below. Contractor's maintenance of insurance, its scope of coverage, and limits as required herein shall not be construed to limit the liability of the Contractor to the coverage provided by such insurance, or otherwise limit the Contracting Agency's recourse to any remedy available at law or in equity.

All deductibles and self-insured retentions must be disclosed and are subject to approval by the Contracting Agency. The cost of any claim payments falling within the deductible or self-insured retention shall be the responsibility of the Contractor. In the event an additional insured incurs a liability subject to any policy's deductibles or self-insured retention, said deductibles or self-insured retention shall be the responsibility of the Contractor.

1-07.18(5)A Commercial General Liability

Commercial General Liability insurance shall be written on coverage forms at least as broad as ISO occurrence form CG 00 01, including but not limited to liability arising from premises, operations, stop gap liability, independent contractors, products-completed operations, personal and advertising injury, and liability assumed under an insured contract. There shall be no exclusion for liability arising from explosion, collapse or underground property damage.

The Commercial General Liability insurance shall be endorsed to provide a per project general aggregate limit, using ISO form CG 25 03 05 09 or an equivalent endorsement.

Contractor shall maintain Commercial General Liability Insurance arising out of the Contractor's completed operations for at least three years following Substantial Completion of the Work.

Such policy must provide the following minimum limits:

$1,000,000 Each Occurrence

$2,000,000 General Aggregate

$2,000,000 Products & Completed Operations Aggregate

$1,000,000 Personal & Advertising Injury each offence

$1,000,000 Stop Gap / Employers' Liability each accident

1-07.18(5)B Automobile Liability

Automobile Liability shall cover owned, non-owned, hired, and leased vehicles; and shall be written on a coverage form at least as broad as ISO form CA 00 01. If the work involves the transport of pollutants, the automobile liability policy shall include MCS 90 and CA 99 48 endorsements.

Such policy must provide the following minimum limit:

$1,000,000 Combined single limit each accident

1-07.18(5)C Workers' Compensation

The Contractor shall comply with Workers' Compensation coverage as required by the Industrial Insurance laws of the State of Washington.

1-07.18(5)D Builder's Risk Insurance

Builder's Risk Insurance providing Broad Perils (All Risk) coverage upon any work at the site, to the full insurable value thereof. This insurance shall include the Contractor, its subcontractors of every tier, and the Contracting Agency as named insured on the policy. Coverage shall be included for all materials and supplies to be incorporated into the work at the jobsite, while in transit to the jobsite, or while stored away from the jobsite.

1-07.19 Gratuities

The Contractor shall not extend any loan, gratuity, or gift of money in any form whatsoever to any employee or officer of the Contracting Agency; nor will the Contractor rent or purchase any equipment or materials from any employee or officer of the Contracting Agency. Before payment of the final estimate will be made, the Contractor shall execute and furnish the Contracting Agency an affidavit certifying compliance with these provisions of the Contract.

The Contractor shall comply with all applicable sections of the State Ethics law, RCW 42.52, which regulates gifts to State officers and employees. Under that statute, any Contracting Agency officer or employee who has or will participate with the Contractor regarding any aspect of this Contract is prohibited from seeking or accepting any gift, gratuity, favor or anything of economic value from the Contractor. Accordingly, neither the Contractor nor any agent or representative shall offer anything of economic value as a gift, gratuity, or favor directly or indirectly to any such officer or employee.

1-07.20 Patented Devices, Materials, and Processes

The Contractor shall assume all costs arising from the use of patented devices, materials, or processes used on or incorporated in the Work, and agrees to indemnify, defend, and save harmless the State, Governor, Commission, Secretary, and their duly authorized agents and employees from all actions of any nature for, or on account of the use of all patented devices, materials, or processes.

1-07.21 Rock Drilling Safety Requirements

It shall be the Contractor's responsibility to maintain safe working conditions during rock drilling, by keeping dust concentration below the threshold limit value or by providing those protective devices that may be required by the State Department of Labor and Industries.

1-07.22 Use of Explosives

Explosives shall not be used on this project.

1-07.23 Public Convenience and Safety

The Contractor shall be responsible for providing adequate safeguards, safety devices, protective equipment, and any other needed actions to protect the life, health, and safety of the public, and to protect property in connection with the performance of the Work covered by the Contract. The Contractor shall perform any measures or actions the Engineer may deem necessary to protect the public and property. The responsibility and expense to provide this protection shall be the Contractor's except that which is to be furnished by the Contracting Agency as specified in other sections of these Specifications. Nothing contained in this Contract is intended to create any third-party beneficiary rights in favor of the public or any individual utilizing the Highway facilities being constructed or improved under this Contract.

1-07.23(1) Construction Under Traffic

The Contractor shall conduct all operations with the least possible obstruction and inconvenience to the public. The Contractor shall enter interstate Highways only through legal movements from existing roads, streets, and through other access points specifically allowed by the Contract documents.

To disrupt public traffic as little as possible, the Contractor shall permit traffic to pass through the Work with the least possible inconvenience or delay. The Contractor shall maintain existing roads, streets, sidewalks, and paths within the project limits, keeping them open and in good, clean, safe condition at all times. Deficiencies caused by the Contractor's operations shall be repaired at the Contractor's expense. The Contractor shall also maintain roads, streets, sidewalks, and paths adjacent to the project limits when affected by the Contractor's operations. The Contractor shall perform the following:

1. Remove or repair conditions resulting from the Work that might impede traffic or create a hazard.
2. Keep existing traffic signal and Highway lighting systems in operation as the Work proceeds. (The Contracting Agency will continue the routine maintenance on such system.)
3. Maintain the striping on the Roadway at the Contracting Agency's expense. The Contractor shall be responsible for scheduling when to renew striping, subject to the approval of the Engineer. When the scope of the project does not require Work on the Roadway, the Contracting Agency will be responsible for maintaining the striping.
4. Maintain existing permanent signing. Repair of signs will be at the Contracting Agency's expense, except those damaged due to the Contractor's operations.
5. Keep drainage Structures clean to allow for free flow of water. Cleaning of existing drainage Structures will be at the Contracting Agency's expense when approved by the Engineer, except when flow is impaired due to the Contractor's operations.

To protect the rights of abutting property owners, the Contractor shall:

1. Conduct the construction so that the least inconvenience as possible is caused to abutting property owners;
2. Maintain ready access to driveways, houses, and buildings along the line of Work;
3. Provide temporary approaches to crossing or intersecting roads and keep these

approaches in good condition; and

4. Provide another access before closing an existing one whenever the Contract calls for removing and replacing an abutting owner's access.

The Contractor shall conduct all operations to minimize drop-offs (abrupt changes in roadway elevation) left exposed to traffic during nonworking hours. Unless otherwise specified in the Traffic Control Plan, drop-offs left exposed to traffic during nonworking hours shall be protected as follows with an accepted traffic control plan submittal in accordance with Section 1-10.2(2):

1. Drop-offs up to 0.20 foot, unless otherwise ordered by the Engineer, may remain exposed with appropriate warning signs alerting motorists of the condition.
2. Drop-offs more than 0.20 foot that are in the Traveled Way or Auxiliary Lane will not be allowed unless protected with appropriate warning signs and further protected as indicated in 3b or 3c below.
3. Open trenches within the Traveled Way or Auxiliary Lane shall have a steel-plate cover placed and anchored over them. A wedge of suitable material, if required, shall be placed for a smooth transition between the pavement and the steel plate. Warning signs shall be used to alert motorists of the presence of the steel plates.

1-07.23(2) Vacant

1-07.23(3) Work Zone Clear Zone

On roadways adjacent to the project, the Work Zone Clear Zone (WZCZ) applies during working and nonworking hours. The WZCZ applies only to temporary roadside objects introduced by the Contractor's operations and does not apply to preexisting conditions or permanent Work. Those work operations that are actively in progress shall be in accordance with adopted and approved Traffic Control Plans, and other contract requirements.

During nonworking hours equipment or materials shall not be within the WZCZ unless they are protected by permanent guardrail or temporary concrete barrier. The use of temporary concrete barrier shall be permitted only if the Engineer approves the installation and location.

During actual hours of work, unless protected as described above, only materials absolutely necessary to construction shall be within the WZCZ and only construction vehicles absolutely necessary to construction shall be allowed within the WZCZ or allowed to stop or park on the shoulder of the roadway.

The Contractor's nonessential vehicles and employees private vehicles shall not be permitted to park within the WZCZ at any time unless protected as described above.

Deviation from the above requirements shall not occur unless the Contractor has requested the deviation in writing and the Engineer has provided written approval.

Minimum WZCZ distances are measured from the edge of traveled way and will be determined as follows:

Minimum Work Zone Clear Zone Distance	
Regulatory Posted Speed	Distance From Traveled Way (Feet)
35 mph or less	10
40 mph	15
45 to 50 mph	20
55 to 60 mph	30
65 mph or greater	35

1-07.24 Rights of Way

Street Right of Way lines, limits of easements, and limits of construction permits are indicated in the Plans.

Generally, the Contracting Agency will have obtained, prior to bid opening, all rights of way and easements, both permanent and temporary, necessary for carrying out the work. Exceptions to this are noted in the Bid Documents or will be brought to the Contractor's attention by a duly issued Addendum.

Whenever easements or rights of entry have not been acquired prior to advertising, these areas are so noted in the Plans. The Contractor shall not proceed with any portion of the work in areas where right of way, easements or rights of entry have not been acquired until the Engineer certifies to the Contractor that the right of way or easement is available or that the right of entry has been received. If the Contractor is delayed due to acts of omission on the part of the Contracting Agency in obtaining easements, rights of entry or right of way, the Contractor will be entitled to an extension of time. The Contractor agrees that such delay shall not be a breach of contract.

Each property owner shall be given 48 hours' notice prior to entry by the Contractor. This includes entry onto easements and private property where private improvements must be adjusted.

The Contractor shall be responsible for providing, without expense or liability to the Contracting Agency, any additional land and access thereto that the Contractor may desire for temporary construction facilities, storage of materials, or other Contractor needs. However, before using any private property, whether adjoining the work or not, the Contractor shall file with the Engineer a written permission of the private property owner, and, upon vacating the premises, a written release from the property owner of each property disturbed or otherwise interfered with by reasons of construction pursued under this contract. The statement shall be signed by the private property owner, or proper authority acting for the owner of the private property affected, stating that permission has been granted to use the property and all necessary permits have been obtained or, in the case of a release, that the restoration of the property has been satisfactorily accomplished. The statement shall include the parcel number, address, and date of

signature. Written releases must be filed with the Engineer before the Completion Date will be established.

1-07.25 Vacant

1-07.26 Personal Liability of Public Officers

Neither the County Commissioners, the Engineer, nor any other officer or employee of the Contracting Agency shall be personally liable for any acts or failure to act in connection with the Contract, it being understood that in such matters, they are acting solely as agents of the Contracting Agency.

1-07.27 No Waiver of State's Legal Rights

The Contracting Agency shall not be precluded or estopped by any measurement, estimate, or certificate made either before or after the completion and acceptance of the Work and payment therefore from showing the true amount and character of the Work performed and materials furnished by the Contractor, or from showing that any such measurement, estimate, or certificate is untrue or incorrectly made, or that the Work or materials do not conform in fact to the Contract. The Contracting Agency shall not be precluded or estopped, notwithstanding any such measurement, estimate, or certificate, and payment in accordance therewith, from recovering from the Contractor and the Sureties such damages as it may sustain by reason of the Contractor's failure to comply with the terms of the Contract. Neither the acceptance by the Contracting Agency, nor any payment for the whole or any part of the Work, nor any extension of time, nor any possession taken by the Contracting Agency shall operate as a waiver of any portion of the Contract or of any power herein reserved or any right to damages herein provided, or bar recovery of any money wrongfully or erroneously paid to the Contractor. A waiver of any breach of the Contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor and the Contracting Agency recognize that the impact of overcharges to the State by the Contractor resulting from antitrust law violations by the Contractor's suppliers or subcontractors adversely affect the State rather than the Contractor. Therefore, the Contractor agrees to assign to the State any and all claims for such overcharges.

1-08 Prosecution and Progress

1-08.0 Preliminary Matters

1-08.0(1) Preconstruction Conference

Prior to the Contractor beginning the work, a preconstruction conference will be held between the Contractor, the Engineer and such other interested parties as may be invited. The purpose of the preconstruction conference will be:

1. To review the initial progress schedule;
2. To establish a working understanding among the various parties associated or affected by the work;
3. To establish and review procedures for progress payment, notifications, approvals, submittals, etc.;
4. To establish normal working hours for the work;

5. To review safety standards and traffic control; and
6. To discuss such other related items as may be pertinent to the work.

The Contractor shall prepare and submit at the preconstruction conference the following:

1. A breakdown of all lump sum items;
2. A preliminary schedule of working drawing submittals; and
3. A list of material sources for approval if applicable.

1-08.0(2) Hours of Work

Except in the case of emergency or unless otherwise approved by the Engineer, the normal working hours for the Contract shall be any consecutive 8-hour period between 7:00 a.m. and 6:00 p.m. Monday through Friday, exclusive of a lunch break. If the Contractor desires different than the normal working hours stated above, the request must be submitted in writing prior to the preconstruction conference, subject to the provisions below. The working hours for the Contract shall be established at or prior to the preconstruction conference.

All working hours and days are also subject to local permit and ordinance conditions (such as noise ordinances).

If the Contractor wishes to deviate from the established working hours, the Contractor shall submit a written request to the Engineer for consideration. This request shall state what hours are being requested, and why. Requests shall be submitted for review no later than 2 working days prior to the day(s) the Contractor is requesting to change the hours.

If the Contracting Agency approves such a deviation, such approval may be subject to certain other conditions, which will be detailed in writing. For example:

1. Requiring the Contractor to reimburse the Contracting Agency for the costs in excess of straight-time costs for Contracting Agency representatives who worked during such times. (The Engineer may require designated representatives to be present during the work. Representatives who may be deemed necessary by the Engineer include, but are not limited to: survey crews; personnel from the Contracting Agency's material testing lab; inspectors; and other Contracting Agency employees or third party consultants when, in the opinion of the Engineer, such work necessitates their presence.)
2. Considering the work performed on Saturdays, Sundays, and holidays as working days with regard to the contract time.
3. Considering multiple work shifts as multiple working days with respect to contract time even though the multiple shifts occur in a single 24-hour period.
4. If a 4-10 work schedule is requested and approved the non-working day for the week will be charged as a working day.
5. If Davis Bacon wage rates apply to this Contract, all requirements must be met and recorded properly on certified payroll.

1-08.1 Subcontracting

1-08.1(1) General

For purposes of this Section, all Work that is not self-performed by the Contractor will be considered as subcontracting except the following, hereinafter referred to as materials supplying: (1) when purchased directly by the Contractor - sand, gravel, crushed stone, crushed slag, batched concrete aggregates, ready-mix concrete, off-site fabricated structural steel, other off-site fabricated items, and any other materials supplied by established and recognized commercial plants; or (2) delivery of these materials to the Work site in vehicles owned or operated by such plants or by recognized independent or commercial hauling companies hired by those commercial plants.

References to subcontractors of a given tier mean the tier in relation to the Contractor. For example, first-tier subcontractors all hold a contract directly with the Contractor, known as a first-tier subcontract. Second-tier subcontractors all hold a contract with a first-tier subcontractor, known as a second-tier subcontract.

1-08.1(2) Self-Performance Requirements

Work done by the Contractor's own organization shall account for at least 30 percent of the Awarded Contract price.

Work done by the first-tier subcontractor's own organization shall account for at least 30 percent of its subcontract price.

Self-performance requirements of other subcontractors, such as DBE, SVBE, or MWBE, shall apply only when included elsewhere in the Contract. In the event of a conflict between specifications, the highest required minimum percentage for self-performance shall take precedence.

1-08.1(3) Subcontractor Approval

Work shall not be subcontracted at any tier unless the Engineer approves in advance and in writing. Each request to subcontract shall be submitted on WSDOT Form 421-012, Request to Sublet. If the Engineer requests proof that a subcontractor, of any tier, has the record, experience, equipment, and ability the Work requires, the Contractor shall provide such proof.

The Engineer will approve the request only if the proposed subcontractor meets the Contract requirements and the Engineer is satisfied with the proposed subcontractor's record, equipment, experience, and ability. Approval to subcontract, at all tiers, shall not:

1. Relieve the Contractor of responsibility to carry out the Contract,
2. Relieve the Contractor of obligations or liability under the Contract and the Contractor's bond,
3. Create a contract between the Contracting Agency and the subcontractor, or
4. Convey to the subcontractor any rights against the Contracting Agency.

1-08.1(4) Requests to Sublet for First-Tier Subcontractors

Along with the request to sublet for each first-tier subcontractor, the Contractor shall submit documentation which demonstrates that each first-tier subcontractor will self-

perform at least 30% of its contract with the Contractor. This may be demonstrated by submitting the names, scope of work, and subcontract amounts of all second-tier subcontractors that each first-tier subcontractor proposes to use. For purposes of this calculation, the exclusion for materials suppliers described in Section 1-08.1(1) will apply.

1-08.1(5) Restrictions on Subcontracting

The Contractor, as well as subcontractors for all tiers, shall not use businesses (material suppliers, vendors, subcontractors, etc.) with federal purchasing exclusions. Businesses with exclusions are identified by using the System for Award Management web page at www.sam.gov.

1-08.1(6) Removal of Subcontractors

If dissatisfied with any part of the Work performed by a subcontractor of any tier, the Engineer may request in writing that the subcontractor performing the unsatisfactory Work be removed. The Contractor shall comply with this request at once and shall not employ the subcontractor for any further Work under the Contract.

1-08.1(7) Payments to Subcontractors and Lower-Tier Subcontractors

1-08.1(7)A Payment Certification

The Contractor shall certify to the actual amounts paid to all firms that were used as first-tier subcontractors, lower-tier subcontractors, materials suppliers, manufacturers, regular dealers, or service providers on the Contract. This includes all Disadvantaged, Minority, Small, Veteran, or Women's Business Enterprise firms. This Certification shall be submitted to the Engineer on a monthly basis each month between Execution of the Contract and Physical Completion of the Contract using the application available at: https://wsdot.diversitycompliance.com. A monthly report shall be submitted for every month between Execution of the Contract and Physical Completion regardless of whether payments were made or work occurred.

1-08.1(7)B Prompt Payment

The Contractor shall comply with all requirements regarding prompt payment including, but not limited to, the requirements of RCW 39.04.250, 39.76.011, 39.76.020, and 39.76.040.

The Contractor shall make payment to its first-tier subcontractors not later than 10 calendar days after receipt of payment from the Contracting Agency for Work satisfactorily completed by its first-tier subcontractors, to the extent of the first-tier subcontractor's interest therein. Satisfactorily completed Work shall mean when all the associated Contract items of Work have been accomplished and documented as required by the Contracting Agency.

Upon request by any subcontractor or materials supplier at any tier, the Engineer will provide a copy of any or all progress payment estimates the Engineer has made to the Contractor.

1-08.1(7)C Subcontractor Retainage

Requests by the first-tier subcontractor to the Contractor for the release of their retainage or retainage bond shall be in writing.

Within 10 calendar days of the request, the Contractor shall determine if the first-tier subcontract has been satisfactorily completed, including any required lien releases, documentation, and material testing, and shall inform the first-tier subcontractor, in writing, of the Contractor's determination. In determining whether satisfactory completion has been achieved, the Contractor may require the first-tier subcontractor to provide documentation such as certifications and releases, showing that all laborers, lower-tier subcontractors, suppliers of material and equipment, and others involved in the first-tier subcontractor's Work have been paid in full. The Contractor may also require any documentation from the first-tier subcontractor that is required by the first-tier subcontract, or by the Contract between the Contractor and Contracting Agency, or by any applicable law, including but not limited to affidavits of wages paid and material acceptance certifications, to the extent they relate to work performed by the first-tier subcontractor or to any of its lower-tier subcontractors.

If the Contractor determines the first-tier subcontract has been satisfactorily completed, the first-tier subcontractor's retainage or retainage bond shall be released by the Contractor within 10 calendar days from the date of the written notice. If the Contractor determines the first-tier subcontractor has not achieved satisfactory completion of the first-tier subcontract, the Contractor must provide the first-tier subcontractor with written notice stating specifically why the first-tier subcontract work is not satisfactorily completed and what must be done to achieve satisfactory completion. The Contractor shall release the first-tier subcontractor's retainage or retainage bond within 10 calendar days after the first-tier subcontractor has satisfactorily completed the Work identified in the notice.

If the Contractor fails to comply with the requirements of this Section and the first-tier subcontractor's retainage or retainage bond is wrongfully withheld, the Contractor will be subject to the actions described in Section 1-08.1(11). The first-tier subcontractor may also seek recovery against the Contractor under applicable prompt pay statutes in addition to any other remedies provided by the first-tier subcontract or by law.

1-08.1(7)D Contractor or Subcontractor Withholding

"Withholding" (or to Withhold) is the act by the Contractor of making a payment to one of its subcontractors that is less than the payment amount requested by its subcontractor, or the act by a subcontractor of making a payment to its lower-tier subcontractor that is less than the payment amount requested by its lower-tier subcontractor. Withholding includes but is not limited to offsets, back charges, deferrals, adjustments for incorrect invoicing, unsatisfactory performance, damages, and delay costs, and can be either agreed or disputed amounts. Such an amount shall be considered an unresolved Withholding unless the invoice clearly indicates agreement with the purpose and amount of the Withholding. Retainage will not be considered a Withholding unless it is disputed by the subcontractor.

In the event of a Withholding, the entity Withholding the payment shall provide written notice to the entity from which payment is Withheld. This notice should be sent as soon as the decision to Withhold is made, but in no case shall it be later than the date payment would otherwise be due. At the same time the Withholding notice is sent, a copy of the Withholding notice shall be sent to the Engineer. The Contractor shall send the Engineer copies of all Withholding notices it receives from materials suppliers and

subcontractors of any tier, within three calendar days of their receipt.

A Withholding notice shall include an accounting of payments to date, the value and reason(s) for the Withheld amount, and an explanation of what must be done to have the Withheld amount released. If the cause of the Withholding is an improper invoice, the notice shall indicate the exact nature of the impropriety.

The entity from which payment is Withheld shall be paid within eight calendar days after it completes the remedial action identified.

1-08.1(7)E Contracting Agency Withholding Regarding Prompt Pay

Withholding will not be considered resolved until the Contracting Agency receives written confirmation, by the entity from which the payment was Withheld, that either:

1. The Withholding has been paid, or
2. It agrees with the Withholding purpose and amount, and the issue is closed.

In the event any Withholding is not resolved by the time the Contractor's first progress payment is due after the Engineer initially received notice that the Withholding occurred, the Engineer will withhold the same amount from the Contractor, in that progress payment, as the amount of the unresolved Withholding.

1-08.1(7)F Subcontract Disputes Resolution Process

When the Contracting Agency has not received written notice of resolution as described in Section 1-08.1(7)E by the due date of the second progress payment, except when the parties of a Withholding dispute agree to resolve the dispute later, the following shall occur:

1. The party withholding funds shall immediately initiate the dispute resolution process provided in its subcontract with the party from whom the funds are being withheld.
2. The Contractor shall notify the Contracting Agency of the status, or changes in status of all dispute resolutions regarding Withholding.

Disputes triggered by Contracting Agency withholding payment shall be resolved in accordance with Section 1-04.5.

1-08.1(8) Vacant

1-08.1(9) Required Subcontract Clauses

1-08.1(9)A Clauses Required in All First-Tier Subcontracts

The Contractor shall include the following clauses in every first-tier subcontract.

First-tier subcontractors shall self-perform at least 30 percent of the dollar value of their contract with the Contractor. For purposes of calculating this percentage, all work that is not performed by the Contractor will be considered as subcontracting except: (1) purchase of sand, gravel, crushed stone, crushed slag, batched concrete aggregates, ready-mix concrete, off-site fabricated structural steel, other off-site fabricated items, and any other materials supplied by established and recognized commercial plants; or (2) delivery of these materials to the Work site in vehicles owned or operated by such plants or by recognized independent or commercial hauling companies hired by those commercial plants.

1-08.1(9)B Clauses Required in Subcontracts of All Tiers

The Contractor shall include in all of its first-tier subcontracts - and shall require subcontracts at all tiers to include - the following clauses, in addition to any subcontract clauses required elsewhere in the Contract.

Prior to subcontracting any Work, the Contractor shall verify that every first-tier subcontractor meets the criteria stated in items 1 through 5 at the time of subcontract execution.

1. Every subcontractor shall possess any electrical contractor license required by RCW 19.28 or elevator contractor license required by RCW 70.87, if applicable;
2. Every subcontractor shall have a certificate of registration in compliance with chapter RCW 18.27;
3. Every subcontractor shall have a current State unified business identifier number;
4. Every subcontractor shall, if applicable, have:
   a. Industrial insurance coverage for the bidder's employees working in Washington (Title 51 RCW);
   b. An employment security department number (Title 50 RCW);
   c. A State excise tax registration number (Title 82 RCW);
5. No subcontractor shall be used that is disqualified from bidding on any public works contract under RCW 39.06.010 or RCW 39.12.065(3).
6. All subcontracts shall comply with Section 1-07.9, including the requirements to furnish all certificates and statements required by the Contract.
7. All subcontracts shall have a dispute resolution process incorporated for resolving issues between the parties to the subcontract.
8. Section 1-08.1(3) Subcontractor Approval
9. Section 1-08.1(5) Restrictions on Subcontracting
10. Section 1-08.1(6) Removal of Subcontractors
11. Section 1-08.1(7)B Prompt Payment
    When incorporating this into subcontracts to which the Contractor is not a party, all duties, rights, and responsibilities of the Contractor shall be understood to adhere to the upper tier subcontractor; all duties, rights, and responsibilities of the first-tier subcontractor shall be understood to adhere to the lower-tier subcontractor.
12. Section 1-08.1(7)C Subcontractor Retainage
    When incorporating this into subcontracts to which the Contractor is not a party, all duties, rights, and responsibilities of the Contractor shall be understood to adhere to the upper tier subcontractor; all duties, rights, and responsibilities of the first-tier subcontractor shall be understood to adhere to the lower-tier subcontractor.
13. Section 1-08.1(7)D Contractor or Subcontractor Withholding
    Regarding the requirements for providing copies of notices to the Engineer, all communications from subcontractors at any tier shall be transmitted through higher tier subcontractors and the Contractor before going to the Engineer.
14. 1-08.1(7)E Contracting Agency Withholding Related to Prompt Pay

Regarding the requirements for providing copies of notices to the Engineer, it shall be understood that all communications from subcontractors at any tier shall be transmitted through higher tier subcontractors and the Contractor before going to the Engineer.

15. 1-08.1(7)F Subcontract Disputes Resolution Process

1-08.1(10) Failure to Comply

Failure by the Contractor to comply with the requirements of Section 1-08.1 may result in one or more of the following actions being taken against the Contractor:

1. Reflected in the Prime Contractor's Performance Evaluation.
2. Cancellation, termination, or suspension of the Contract, in whole or in part.
3. Sanctions as provided by the Contract or by law under applicable prompt payment statutes including RCW 39.04.250.
4. Suspension, revocation, or limitation of prequalification status as provided for in WAC 468-16 *et seq*.

1-08.1(11) Payment

Unless otherwise stated in Section 1-08.1, the Contractor shall be solely responsible for all costs related to complying with Section 1-08.1. Those costs shall be incidental to the respective Bid items.

1-08.2 Assignment

The Contractor shall not assign all or any part of the Work unless the Engineer approves in writing. The Engineer will not approve any proposed assignment that would relieve the original Contractor or Surety of responsibility under the Contract.

Money due (or that will become due) to the Contractor may be assigned. If given written notice, the Contracting Agency will honor such an assignment to the extent the law permits. But the assignment shall be subject to all setoffs, withholdings, and deductions required by law and the Contract.

1-08.3 Progress Schedule

1-08.3(1) General Requirements

The Contractor shall submit a Type B Progress Schedule and Schedule Updates to the Engineer for approval. Schedules shall show Work that complies with all time and order of Work requirements in the Contract. Scheduling terms and practices shall conform to the standards established in *Construction Planning and Scheduling, Second Edition*, published by the Associated General Contractors of America. Except for Weekly Look-Ahead Schedules, all schedules shall meet these General Requirements, and provide the following information:

1. Include all activities necessary to physically complete the project.
2. Include priority and long lead time material submittals per Section 1-08.4(1)d.
3. Show the planned order of Work activities in a logical sequence.
4. Show durations of Work activities in working days as defined in Section 1-08.5.
5. Show activities in durations that are reasonable for the intended Work.

6. Define activity durations in sufficient detail to evaluate the progress of individual activities on a daily basis.
7. Show the Physical Completion of all Work within the authorized Contract time. Total float belongs to the project and shall not be for the exclusive benefit of either party.

The Contracting Agency allocates its resources to a Contract based on the total time allowed in the Contract. The Contracting Agency may accept a Progress Schedule indicating an early Physical Completion Date but cannot guarantee the Contracting Agency's resources will be available to meet an accelerated schedule. No additional compensation will be allowed if the Contractor is not able to meet their accelerated schedule due to the unavailability of Contracting Agency's resources or for other reasons beyond the Contracting Agency's control.

If the Engineer determines that the Progress Schedule or a Schedule Update submitted in accordance with Section 1-08.3(3) does not provide the required information, then the schedule will be returned to the Contractor for correction and resubmittal.

The Engineer's approval of schedules shall not transfer the Contractor's responsibilities to the Contracting Agency. The Contractor alone shall remain responsible for adjusting forces, equipment, and Work schedules to ensure completion of the Work within the time(s) specified in the Contract.

1-08.3(2) Progress Schedule Types

Type B Progress Schedule, Weekly Look-Ahead Schedules and Schedule Updates are required on this project.

1-08.3(2)A Vacant

1-08.3(2)B Type B Progress Schedule

The Contractor shall submit a preliminary Type B Progress Schedule at or prior to the preconstruction conference. The preliminary Type B Progress Schedule shall comply with all of these requirements and the requirements of Section 1-08.3(1), except that it may be limited to only those activities occurring within the first 60-working days of the project.

The Contractor shall submit a copy of the Type B Progress Schedule in an electronic format acceptable to the engineer, depicting the entire project no later than 21-calendar days after the preconstruction conference. The schedule shall be a critical path method (CPM) schedule developed by the Precedence Diagramming Method (PDM). Restraints may be utilized, but may not serve to change the logic of the network or the critical path. The schedule shall display at least the following information:

Contract Number and Title
Construction Start Date
Critical Path
Activity Description
Milestone Description
Activity Duration
Predecessor Activities
Successor Activities

Early Start (ES) and Early Finish (EF) for each activity
Late Start (LS) and Late Finish (LF) for each activity
Total Float (TF) and Free Float (FF) for each activity
Physical Completion Date
Data Date

The Type B Progress Schedule will be reviewed 10 days after submission in a meeting between the Contracting Agency and the Contractor to discuss the logic of the schedule. The meeting shall include major subcontractors, or subcontractors requested by the Contracting Agency.

1-08.3(2)C Vacant

1-08.3(2)D Weekly Look-Ahead Schedule

Each week that Work will be performed, the Contractor shall submit a Weekly Look-Ahead Schedule showing the Contractor's and all Subcontractors' proposed Work activities for the next three weeks, and the previous week. The Weekly Look-Ahead Schedule shall include the description, duration and sequence of Work, along with the planned hours of Work. This schedule may be a network schedule, bar chart, or other standard schedule format. The Weekly Look-Ahead Schedule shall be submitted to the Engineer by the midpoint of the week preceding the scheduled Work or some other mutually agreed upon submittal time.

1-08.3(3) Schedule Updates

The Engineer may request a Schedule Update when one or more of the following events occurs:

1. The project has experienced a change that affects the critical path.
2. The sequence of Work is changed from that in the approved schedule.
3. The project is significantly delayed.
4. Upon receiving an extension of Contract time.
5. Monthly with Progress Payments unless relieved by the Contracting Agency.

The Contractor shall submit a Type B Schedule Update within 15 calendar days of receiving a written request, or when an update is required by any other provision of the Contract. A "significant" delay in time is defined as 10 working days or 10 percent of the original Contract time, whichever is greater.

In addition to the other requirements of this section, Schedule Updates shall reflect the following information:

1. The actual duration and sequence of as-constructed Work activities, including changed Work.
2. Approved time extensions.
3. Construction delays or other conditions that affect the progress of the Work.
4. Modifications to the as-planned sequence or duration of remaining activities.
5. The Physical Completion of all remaining Work in the remaining Contract time.

Unresolved requests for time extensions shall be reflected in the Schedule Update by assuming no time extension will be granted, and by showing the effects to follow-on activities necessary to physically complete the project within the currently authorized time for completion.

1-08.3(4) Vacant

1-08.3(5) Payment

Payment will be made for the following Bid item: “Type B Progress Schedule,” lump sum.

The lump sum price shall be full pay for all costs for furnishing the Type B Progress Schedule and preliminary Type B Progress Schedule.

Payment of 20-25% percent of the lump sum price will be made upon approval of the Progress Schedule.

Payment will be increased at the discretion of the Contracting Agency for each schedule update when requested by the Engineer. Full payment for the bid item will be made when the work is substantially complete.

All costs for providing Weekly Look-Ahead Schedules are considered incidental to other items of Work in the Contract.

A minimum bid amount has been entered in the Bid Proposal for this item. The Contractor must bid at least that amount.

1-08.4 Prosecution of Work

1-08.4(1) Preconstruction Work Phase

This Section specifies planning and work included within the Preconstruction Work Phase that takes place during the period after the Limited Notice to Proceed and prior to the start of the work authorized by the Notice to Proceed with Construction. The limited Notice to Proceed will be issued immediately after execution of the Contract. The Preconstruction Work Phase is limited to 30 Calendar days unless otherwise approved by the Engineer.

The planning effort includes identifying and organizing the Contractor’s work team, attending a preconstruction public meeting whose purpose is to introduce the Contractor to the public impacted by the project, planning the construction activities with the Engineer, establishing the initial survey control, preparing and delivering priority submittals for equipment, and other activities related to planning activities identified herein.

To accomplish the preconstruction activities, the Contractor shall provide staff to meet on the project site as needed and shall establish and maintain an office in the Puget Sound region to accomplish the work. Satisfactory completion of the Preconstruction Work Phase activities will be a prerequisite to the Notice to Proceed with Construction for the Construction Work Phase.

Submittal information shall be provided in sufficient detail to verify compliance with the specifications during the Preconstruction Work Phase and shall be provided prior to Notice to Proceed with Construction for the Construction Work Phase. The

Contractor shall make arrangements with subcontractors and suppliers for the preparation and submittal of required documentation.

Payment

Costs not covered by other bid items and associated with, including but not limited to, documenting, revising, updating, maintaining, and submitting all materials and data required in this section shall be included in the Bid Item “Mobilization” in accordance with Section 1-09.7.

1-08.4(1)a Activities

The following is a list of the activities to be included in the Preconstruction Work Phase. Each of the activities and required work products are defined either within this specification or in specification sections in the Special Provisions.

1. Contractor's Management and Work Plan
2. Project Safety and Accident Prevention Program
3. Preconstruction Photographs
4. Submittals
    a. Submittal Plan and Schedule
    b. Priority or Long Lead Time Material Submittals
    c. Priority Technical Submittals
    d. Erosion Control Plan(s)
    e. Sheeting, Shoring, and Bracing Plan(s)
    f. Spill Prevention, Control, and Countermeasures Plan
    g. Temporary Traffic Control Plans
    h. Health and Safety Plan
5. Apply for and provide schedule for anticipated completion of contractor-furnished permits – deferred submittals for the permits include:
    a. Fire Sprinklers Flow Alarm
    b. Fire Sprinklers
    c. Fire Stopping
    d. Metal Guardrails and Handrails
    e. Salt Storage Structure
    f. Covered Parking and Storage Structures
    g. Street Sweeping & Brine Maker Storage Structure
    h. Vehicle Wash Structure
    i. Vehicle Wash
    j. Fire Alarm
    k. Photo Voltaic System (10 kilowatts in base bid, additional 89.5 kilowatts in additive alternate bid)

l. Overhead bridge crane
m. Storefront System
n. Mechanical Equipment Anchorage
o. Structural Earth Walls
p. Pallet Racks
q. Metal Stairs
r. Cantilever Storage Rack
s. Signage Permit
t. Stormwater Structures

6. Schedules
   a. Contractor's Scheduler Qualifications
   b. Schedule of Values for Lump Sum Bid Items
   c. Contractor's Construction Schedule
7. Attend Procore Training
8. Attend Public Meeting

1-08.4(1)b Contractor's Management and Work Plan

Contractor shall prepare and submit a plan describing in detail the approach and methods for prosecuting the work in accordance with the contract. The Management Plan shall include the following:

1. An organizational chart describing:
   a. The hierarchy and relationship of the Contractor's project staff;
   b. The hierarchy of subcontractors and suppliers including the trade(s) or portion(s) for which each is responsible; and
   c. A resume for the proposed Project Manager and/or site superintendent.
2. An address and phone directory of the Contractor, Subcontractor, and priority equipment suppliers.
3. A narrative describing how the Contractor intends to staff, equip, and supply the job by trade in order to meet the contract work sequence and schedule constraints. Include the size of the work crew, description of on-site equipment, working hours, and requirements for material and equipment procurement, laydown, and storage.
4. Provide rates for craft labor likely to be used to complete the Work in accordance with Section 1-07.9(1). At a minimum, provide basic wage and benefits cost, worker’s insurance costs, federal insurance costs, safety costs, and travel allowance costs, if applicable. Craft labor cost for the Contractor and all his subcontractors shall be provided.
5. Provide rates for equipment likely to be used to complete the Work. At a minimum, provide complete equipment description, hourly cost, operating cost per hour, and operated cost per hour. Equipment cost for the Contractor and all

their subcontractors shall be provided.

1-08.4(1)c Project Safety and Accident Prevention Program

Contractor shall prepare and submit a Safety and Accident Prevention Program. This program shall outline the anticipated hazards and safety controls necessary to safeguard Contractor's employees, the public, Kitsap County staff and Kitsap County representatives. It shall be specific to the job and site and meet federal, state and local jurisdictional requirements. The program will be reviewed for compliance with this Section prior to the start of work.

1-08.4(1)d Submittals

Prepare and submit the Submittal Control Document in accordance with Section 1-06.0.

Priority Technical Submittals:

Contractor shall provide submittals in accordance with Section 1-06.1 for all priority submittals and for materials that may take more than six (6) weeks to be obtained. Prior to submission of priority or long lead time material submittals, Contractor shall schedule pre-submittal meetings with the Engineer as deemed appropriate. All submittals identified as priority or long lead time materials shall be shown on the Type B Schedule.

Priority technical submittals have been identified which have an impact on work activities starting immediately following Notice to Proceed for construction. The list includes but may not be limited to the following items. Should the Contractor's schedule identify a critical submittal not listed, preparation and submittal shall be performed during the preconstruction period:

1. Provide an Erosion Control Plan identifying erosion control measures to be used by the Contractor, including those already shown and specified.
2. Provide a Sheeting, Shoring, and Bracing Plan. Information to be provided shall at a minimum include the following:
    a. Design calculations and method of installation and removal of all Sheeting, Sheet Piling, Shoring, and Bracing. Calculations shall be made by a Washington State registered structural or civil engineer and shall comply with applicable requirements of the Washington State Safety Code and the rules of the WISHA Department of Labor and Industries with respect to excavation and construction.
    b. Detailed excavation support drawings.
3. Provide a Spill Prevention, Control and Countermeasures Plan per Section 1-07.15.
4. Provide Temporary Traffic Control Plans in accordance with Section 1-10.
5. Health and Safety Plan.

1-08.4(1)e Contractor Furnished Permits

The Contractor shall apply for and obtain the Contractor Furnished Permits during the Preconstruction Work Phase.

1-08.4(1)f Schedules

The Contractor shall submit the Contractor's scheduling qualifications including the resume(s) of the designated person(s) responsible for schedules and reports (the "Contractor's Scheduler"). The Contractor's Scheduler shall have demonstrable capability to plan, coordinate, execute, and monitor a CPM schedule as required for this Project. The Engineer will approve or reasonably disapprove the Contractor's proposed scheduler. In the event of disapproval, a new scheduler shall be proposed within one week and be subject to the same consideration criteria as noted above. In addition, the Contractor shall prepare and submit the following schedule information:

1. Schedule of Values for the lump sum Bid items included in the Bid Proposal.
2. Contractor's Construction Schedule

1-08.4(1)g Attend Procore Training

Contractor shall attend Procore training in accordance with Section 1-05.17(2).

1-08.4(1)h Attend Public Meeting

Contractor shall attend one public meeting during the Preconstruction Work Phase to be introduced to the public that may be impacted by the project.

1-08.4(2) Notice to Proceed and Prosecution of Work

Notice to Proceed will be given after the contract has been executed, the contract bond and evidence of insurance have been approved and filed by the Contracting Agency and the items listed above in the preconstruction work phase have been completed or 30 Calendar days after the Limited Notice to Proceed.

The Contractor shall not commence with the work until the Notice to Proceed has been given by the Engineer. The Contractor shall commence construction activities on the project site within ten days of the Notice to Proceed Date, unless otherwise approved in writing. The Contractor shall diligently pursue the work to the physical completion date within the time specified in the contract. Voluntary shutdown or slowing of operations by the Contractor shall not relieve the Contractor of the responsibility to complete the work within the time(s) specified in the contract.

The first order of work shall be the installation of high visibility fencing to delineate all areas for protection or restoration along the project corridor as shown in the Contract Plans or as directed by the Engineer. Installation of high visibility fencing adjacent to the roadway shall occur after the placement of all necessary signs and traffic control devices in accordance with 1-10.1(2). Upon construction of the fencing, the Contractor shall request the Engineer to inspect the fence. No other work shall be performed on the site until the Contracting Agency has accepted the installation of high visibility fencing, as described in the Contract.

1-08.4(3) Preconstruction Conference

The Contractor shall attend this preconstruction conference. The Contracting Agency will develop the agenda.

1-08.4(4) Progress Meetings

The Contractor shall participate in weekly progress meetings. The purpose of the weekly progress meetings will be to review:

1. Progress, working days remaining, and the weekly 3 week look ahead schedule;
2. Submittal log and status of reviews;
3. RFI log and status of reviews;
4. Material deliveries;
5. Status of subcontractor paperwork and certified payrolls;
6. Safety issues and daily operations;
7. Quality issues;
8. Issues or changes to the work;
9. Payment issues;
10. Utility coordination;
11. Record Drawings
12. Other related items as may be pertinent to the work.

The Contractor shall prepare and submit at the progress meetings the following:

1. Weekly look ahead schedule
2. Record drawings update; and
3. Other items as may be pertinent to the work.

1-08.5 Time for Completion

This project shall be physically completed within **400 working days**.

The Contractor shall complete all physical Contract Work within the number of “working days” stated in the Contract Provisions or as extended by the Engineer in accordance with Section 1-08.8. Every day will be counted as a “working day” unless it is a nonworking day or an Engineer determined unworkable day. A nonworking day is defined as a Saturday, a Sunday, a whole or half day on which the Contract specifically prohibits Work on the critical path of the Contractor’s approved progress schedule, or one of these holidays: January 1, the third Monday of January, the third Monday of February, Memorial Day, June 19, July 4, Labor Day, November 11, Thanksgiving Day, the day after Thanksgiving, and Christmas Day. When any of these holidays fall on a Sunday, the following Monday shall be counted a nonworking day. When the holiday falls on a Saturday, the preceding Friday shall be counted a nonworking day. The days between December 25 and January 1 will be classified as nonworking days.

An unworkable day is defined as a half or whole day the Engineer declares to be unworkable because of weather or conditions caused by the weather that prevents satisfactory and timely performance of the Work shown on the critical path of the Contractor’s approved progress schedule. Other conditions beyond the control of the Contractor may qualify for an extension of time in accordance with Section 1-08.8.

Contract time shall begin on the first working day following the Notice to Proceed Date.

Each working day shall be charged to the contract as it occurs, until the contract work is physically complete. If substantial completion has been granted and all the authorized working days have been used, charging of working days will cease. Each week the Engineer will provide the Contractor a statement that shows the number of working days: (1) charged to the contract the week before; (2) specified for the physical completion of the contract; and (3) remaining for the physical completion of the contract. The statement will also show the nonworking days and any partial or whole day the Engineer declares as unworkable. The statement will be identified as a Written Determination by the Engineer. If the Contractor does not agree with the Written Determination of working days, the Contractor shall pursue the protest procedures in accordance with Section 1-04.5. By failing to follow the procedures of Section 1-04.5, the Contractor shall be deemed as having accepted the statement as correct. If the Contractor is approved to work 10 hours a day and 4 days a week (a 4-10 schedule) and the fifth day of the week in which a 4-10 shift is worked would ordinarily be charged as a working day then the fifth day of that week will be charged as a working day whether or not the Contractor works on that day.

The Engineer will give the Contractor written notice of the Physical Completion Date for all Work the Contract requires. That date shall constitute the Physical Completion Date of the Contract, but shall not imply the Contracting Agency's acceptance of the Work or the Contract.

The Engineer will give the Contractor written notice of the Completion date of the contract after all the Contractor's obligations under the contract have been performed by the Contractor. The following events must occur before the Completion Date can be established:

1. The physical work on the project must be complete; and
2. The Contractor must furnish all documentation required by the contract and required by law, to allow the Contracting Agency to process final acceptance of the contract. The following documents must be received by the Project Engineer prior to establishing a completion date:
    a. Certified Payrolls (per Section 1-07.9(5)).
    b. Material Acceptance Certification Documents
    c. Monthly Reports of Amounts Credited as DBE Participation, as required by the Contract Provisions.
    d. Final Contract Voucher Certification
    e. Copies of the approved "Affidavit of Prevailing Wages Paid" for the Contractor and all Subcontractors
    f. A copy of the Notice of Termination sent to the Washington State Department of Ecology (Ecology); the elapse of 30 calendar days from the date of receipt of the Notice of Termination by Ecology; and no rejection of the Notice of Termination by Ecology. This requirement will not apply if the Construction Stormwater

General Permit is transferred back to the Contracting Agency in accordance with Section 8-01.3(16).

g. Property owner releases per Section 1-07.24

1-08.6 Suspension of Work

The Engineer may order suspension of all or any part of the Work if:

1. Unsuitable weather prevents satisfactory and timely performance of the Work; or
2. The Contractor does not comply with the Contract; or
3. It is in the public interest.

When ordered by the Engineer to suspend or resume Work, the Contractor shall do so immediately.

If the Work is suspended for reason (1) above, the period of Work stoppage will be counted as unworkable days. But if the Engineer believes the Contractor should have completed the suspended Work before the suspension, all or part of the suspension period may be counted as working days. The Engineer will set the number of unworkable days (or parts of days) by deciding how long the suspension delayed the entire project.

If the Work is suspended for reason (2) above, the period of Work stoppage will be counted as working days. The lost Work time, however, shall not relieve the Contractor from the Contract responsibility.

If the performance of all or any part of the Work is suspended, delayed, or interrupted for an unreasonable period of time by an act of the Contracting Agency in the administration of the Contract, or by failure to act within the time specified in the Contract (or if no time is specified, within a reasonable time), the Engineer will make an adjustment for increases in the cost or time for the performance of the Contract (excluding profit) necessarily caused by the suspension, delay, or interruption. However, no adjustment will be made for suspensions, delays, or interruptions if (1) the performance would have been suspended, delayed, or interrupted by other causes, including the fault or negligence of the Contractor, or (2) an equitable adjustment is provided for or excluded under another provision of the Contract.

If the Contractor believes that the performance of the Work is suspended, delayed, or interrupted for an unreasonable period of time and such suspension, delay, or interruption is the responsibility of the Contracting Agency, the Contractor shall immediately submit a written notice of protest to the Engineer within 14 calendar days of the start of the suspension delay or interruption requesting an equitable adjustment. No adjustment shall be allowed for costs incurred more than 14 calendar days before the date the Engineer receives the Contractor’s written notice of protest. The Engineer will issue a Written Determination to the Contractor and adjust payment and time in accordance with this section, if warranted. If the Contractor does not agree with the Written Determination, then the Contractor shall pursue the protest procedures in accordance with Section 1-04.5. The Contractor shall keep full and complete records of the costs and additional time of such suspension, delay, or interruption and shall permit the Engineer to have access to those records and any other records as may be deemed necessary by the Engineer to assist in evaluating the protest.

The Engineer will determine if an equitable adjustment in cost or time is due as provided in this section. The equitable adjustment for increase in costs, if due, shall be subject to the limitations provided in Section 1-09.4, provided that no profit of any kind will be allowed on increases in costs caused by the suspension, delay, or interruption.

Request for extensions of time will be evaluated in accordance with Section 1-08.8.

The Engineer's determination as to whether an adjustment should be made will be final as provided in Section 1-05.1.

By failing to follow procedures of Section 1-04.5, the Contractor completely waives claims for protested Work.

1-08.7 Maintenance During Suspension

Before and during suspensions (as described in Section 1-08.6) the Contractor shall protect the Work from damage or deterioration. Suspension shall not relieve the Contractor from anything the Contract requires.

The Contractor shall protect and maintain the Work. All costs associated with protecting and maintaining such Work shall be the responsibility of the Contractor.

After any suspension, the Contractor shall resume all responsibilities the Contract assigns for the Work.

1-08.8 Extensions of Time

The Contractor shall submit requests for time extensions to the Engineer in writing no later than 14 calendar days after the delay occurs. No adjustment shall be allowed for contract time incurred more than 14 calendar days prior to the date the Engineer receives the Contractor's written request of time extension. The requests for time extension shall be limited to the effect on the critical path of the Contractor's approved schedule attributable to the change or event giving rise to the request.

The Engineer may request additional information regarding the request, to ascertain the basis and amount of the time requested. In addition, the Engineer may request, and the Contractor shall provide within 14 calendar days after Engineer's request, an updated schedule that supports the request and demonstrates that the change or event: (1) had a specific impact on the critical path, and except in cases of concurrent delay, was the sole cause of such impact, and (2) could not have been avoided by resequencing of the Work or by using other reasonable alternatives. Contractor may request additional time to respond to the supplemental information requested by the Engineer. If a request combined with previous extension requests, equals 20 percent or more of the original Contract time then the Contractor's letter of request must bear consent of Surety. In evaluating requests for time extension, the Engineer will consider how well the Contractor used the time from Contract execution up to the point of the delay and the effect the delay had on any completion times included in the Special Provisions. The Engineer will evaluate and issue a Written Determination within 21 calendar days of receiving the request or supplemental information.

The authorized time for Physical Completion will be extended for a period equal to the time the Engineer determines the Work was delayed because of:

1. Adverse weather causing the time requested to be unworkable, provided that the Engineer had not already declared the time to be unworkable and the Contractor has

filed a written protest according to Section 1-08.5.

2. Actions, neglect, or default of the Contracting Agency, its officers, or employees, or of other contractors employed by the Contracting Agency.
3. Fire or other casualty for which the Contractor is not responsible.
4. Strikes.
5. Other conditions for which these Special Provisions permit time extensions such as:
   a. In Section 1-04.4 if a change increases the time to do any of the Work including unchanged Work.
   b. In Section 1-04.5 if increased time is part of a protest that is found to be a valid protest.
   c. In Section 1-04.7 if a changed condition is determined to exist that caused a delay in completing the Contract.
   d. In Section 1-05.3 if the Contracting Agency does not approve properly prepared and acceptable drawings within the time defined in Section 1-05.3.
   e. In Section 1-07.13 if the performance of the Work is delayed as a result of damage by others.
   f. In Section 1-07.17 if the removal or the relocation of a utility by forces other than the Contractor caused a delay.
   g. In Section 1-07.24 if a delay results from all the Right of Way necessary for the construction not being purchased and the Special Provisions does not make specific provisions regarding unpurchased Right of Way.
   h. In Section 1-08.6 if the performance of the Work is suspended, delayed, or interrupted for an unreasonable period of time that proves to be the responsibility of the Contracting Agency.
   i. In Section 1-09.11 if a dispute or claim also involves a delay in completing the Contract and the dispute or claim proves to be valid.
   j. In Section 1-09.6 for Work performed on a force account basis.
6. If the actual quantity of Work performed for a Bid item was more than the original Plan quantity and increased the duration of a critical activity. Extensions of time will be limited to only that quantity exceeding the original Plan quantity.
7. Exceptional causes not specifically identified in items 1 through 6, provided the request letter proves the Contractor had no control over the cause of the delay and could have done nothing to avoid or shorten it.

Working days added to the Contract by time extensions, when time has overrun, shall only apply to days on which liquidated damages or direct engineering have been charged, such as the following:

If Substantial Completion has been granted prior to all of the authorized working days being used, then the number of days in the time extension will eliminate an equal number of days on which direct engineering charges have accrued. If the Substantial Completion Date is established after all of the authorized working days have been used, then the number of days in the time extension will eliminate an equal number

of days on which liquidated damages or direct engineering charges have accrued.

The Engineer will not allow a time extension for causes listed above if it resulted from the Contractor's default, collusion, action or inaction, or failure to comply with the Contract.

The Contracting Agency considers the time specified in the Special Provisions as sufficient to do all the Work. For this reason, the Contracting Agency will not grant a time extension for:

1. Failure to obtain all materials and workers unless the failure was the result of exceptional causes as provided above in Subsection 7;
2. Changes, protests, increased quantities, or changed conditions (Section 1-04) that do not delay the completion of the Contract or prove to be an invalid or inappropriate time extension request;
3. Delays caused by nonapproval of drawings or plans as provided in Section 1-05.3;
4. Rejection of faulty or inappropriate equipment as provided in Section 1-05.9;
5. Correction of thickness deficiency as provided in Section 5-05.5(1)B of the Standard Specifications.

If the Contractor does not agree with the Engineer's Written Determination, the Contractor shall pursue the protest procedures in accordance with Section 1-04.5. By failing to follow the procedures of Section 1-04.5, the Contractor completely waives claims for protested Work.

1-08.9 Liquidated Damages

Time is of the essence of the Contract. Delays cost taxpayers undue sums of money, adding time needed for administration, engineering, inspection, and supervision.

Accordingly, the Contractor agrees:

1. To pay liquidated damages in the amount of ***** $3,700 ***** for each working day beyond the number of working days established for Physical Completion, and
2. To authorize the Engineer to deduct these liquidated damages from any money due or coming due to the Contractor.

When the Contract Work has progressed to Substantial Completion as defined in the Contract, the Engineer may determine the Contract Work is Substantially Complete. The Engineer will notify the Contractor in writing of the Substantial Completion Date. For overruns in Contract time occurring after the date so established, liquidated damages identified above will not apply. For overruns in Contract time occurring after the Substantial Completion Date, liquidated damages shall be assessed on the basis of direct engineering and related costs assignable to the project until the actual Physical Completion Date of all the Contract Work. The Contractor shall complete the remaining Work as promptly as possible. Upon request by the Project Engineer, the Contractor shall furnish a written schedule for completing the physical Work on the Contract.

Liquidated damages will not be assessed for any days for which an extension of time is granted. No deduction or payment of liquidated damages will, in any degree, release the Contractor from further obligations and liabilities to complete the entire Contract.

1-08.10 Termination of Contract

1-08.10(1) Termination for Default

The Contracting Agency may terminate the Contract upon the occurrence of one or more or the following events:

1. If the Contractor fails to supply sufficient skilled workers or suitable materials or equipment;
2. If the Contractor refuses or fails to prosecute the Work with such diligence as will ensure its Physical Completion within the original Physical Completion time plus extensions of time which may have been granted to the Contractor by change order;
3. If the Contractor is adjudged bankrupt or insolvent, or makes a general assignment for the benefit of creditors, or if the Contractor or a third party files a petition to take advantage of a debtor's act or to reorganize under the bankruptcy or similar laws concerning the Contractor, or if a trustee or receiver is appointed for the Contractor or for any of the Contractor's property on account of the Contractor's insolvency, and the Contractor or its successor in interest does not provide adequate assurance of future performance in accordance with the Contract within 15 calendar days of receipt of a request for assurance from the Contracting Agency;
4. If the Contractor disregards laws, ordinances, rules, codes, regulations, orders or similar requirements of any public entity having jurisdiction;
5. If the Contractor disregards the authority of the Contracting Agency;
6. If the Contractor performs Work which deviates from the Contract, and neglects or refuses to correct rejected Work; or
7. If the Contractor otherwise violates in any material way any provisions or requirements of the Contract.

Once the Contracting Agency determines that sufficient cause exists to terminate the Contract, written notice shall be given to the Contractor and its Surety indicating that the Contractor is in breach of the Contract and that the Contractor is to remedy the breach within 15 calendar days after the notice is sent. In case of an emergency such as potential damage to life or property, the response time to remedy the breach after the notice may be shortened. If the remedy does not take place to the satisfaction of the Contracting Agency, the Engineer may, by serving written notice to the Contractor and Surety either:

1. Transfer the performance of the Work from the Contractor to the Surety; or
2. Terminate the Contract and at the Contracting Agency's option prosecute it to completion by contract or otherwise. Extra costs or damages to the Contracting Agency shall be deducted from money due or coming due to the Contractor under the Contract.

If the Engineer elects to pursue one remedy, it will not bar the Engineer from pursuing other remedies on the same or subsequent breaches.

Upon receipt of a notice that the Work is being transferred to the Surety, the Surety shall enter upon the premises and take possession of all materials, tools, and appliances for the purpose of completing the Work included under the Contract and

employ by contract or otherwise any person or persons satisfactory to the Engineer to finish the Work and provide the materials without termination of the Contract. Such employment shall not relieve the Surety of its obligations under the Contract and the bond. If there is a transfer to the Surety, payments on estimates covering Work subsequent to the transfer shall be made to the extent permitted under law to the Surety or its agent without any right of the Contractor to make any claim.

If the Engineer terminates the Contract or provides such sufficiency of labor or materials as required to complete the Work, the Contractor shall not be entitled to receive any further payments on the Contract until all the Work contemplated by the Contract has been fully performed. The Contractor shall bear any extra expenses incurred by the Contracting Agency in completing the Work, including all increased costs for completing the Work, and all damages sustained, or which may be sustained, by the Contracting Agency by reason of such refusal, neglect, failure, or discontinuance of Work by the Contractor. If liquidated damages are provided in the Contract, the Contractor shall be liable for such liquidated damages until such reasonable time as may be required for Physical Completion of the Work. After all the Work contemplated by the Contract has been completed, the Engineer will calculate the total expenses and damages for the completed Work. If the total expenses and damages are less than any unpaid balance due the Contractor, the excess will be paid by the Contracting Agency to the Contractor. If the total expenses and damages exceed the unpaid balance, the Contractor and the Surety shall be jointly and severally liable to the Contracting Agency and shall pay the difference to the Contracting Agency on demand.

In exercising the Contracting Agency's right to prosecute the Physical Completion of the Work, the Contracting Agency shall have the right to exercise its sole discretion as to the manner, method, and reasonableness of the costs of completing the Work. In the event that the Contracting Agency takes Bids for remedial Work or Physical Completion of the project, the Contractor shall not be eligible for the Award of such Contracts.

In the event the Contract is terminated, the termination shall not affect any rights of the Contracting Agency against the Contractor. The rights and remedies of the Contracting Agency under the Termination Clause are in addition to any other rights and remedies provided by law or under this Contract. Any retention or payment of monies to the Contractor by the Contracting Agency will not release the Contractor from liability.

If a notice of termination for default has been issued and it is later determined for any reason that the Contractor was not in default, the rights and obligations of the parties shall be the same as if the notice of termination had been issued pursuant to Termination for Public Convenience in Section 1-08.10(2). This shall include termination for default because of failure to prosecute the Work, and the delay was found to be excusable under the provisions of Section 1-08.8.

1-08.10(2) Termination for Public Convenience

The Engineer may terminate the Contract in whole, or from time to time in part, whenever:

1. The Contractor is prevented from proceeding with the Work as a direct result of an Executive Order of the President with respect to the prosecution of war or in the interest of national defense; or an Executive Order of the President or Governor of

the State with respect to the preservation of energy resources;

2. The Contractor is prevented from proceeding with the Work by reason of a preliminary, special, or permanent restraining order of a court of competent jurisdiction where the issuance of such restraining order is primarily caused by acts or omissions of persons or agencies other than the Contractor; or
3. The Engineer determines that such termination is in the best interests of the Contracting Agency.

1-08.10(3) Termination for Public Convenience Payment Request

After receipt of Termination for Public Convenience as provided in Section 1-08.10(2), the Contractor shall submit to the Contracting Agency a request for costs associated with the termination. The request shall be prepared in accordance with the claim procedures outlined in Sections 1-09.11 and 1-09.12. The request shall be submitted promptly but in no event later than 90 calendar days from the effective date of termination.

The Contractor agrees to make all records available to the extent deemed necessary by the Engineer to verify the costs in the Contractor's payment request.

1-08.10(4) Payment for Termination for Public Convenience

Whenever the Contract is terminated in accordance with Section 1-08.10(2), payment will be made in accordance with Section 1-09.5 for the actual Work performed.

If the Contracting Agency and the Contractor cannot agree as to the proper amount of payment, then the matter will be resolved as outlined in Section 1-09.13 except that, if the termination occurs because of the issuance of a restraining order as provided in Section 1-08.10(2), the matter will be resolved through mandatory and binding arbitration as described in Sections 1-09.13(3)A and B, regardless of the amount of the claim.

1-08.10(5) Responsibility of the Contractor and Surety

Termination of a Contract shall not relieve the Contractor of any responsibilities under the Contract for Work performed. Nor shall termination of the Contract relieve the Surety or Sureties of obligations under the Contract Bond or retainage bond for Work performed.

1-09 Measurement and Payment

1-09.0 North Kitsap Service Center Bid Items

The unit or lump sum Contract Prices shall constitute full payment for the Work as defined in the Contract Documents and shall also constitute full compensation for the work necessary to the completion of the item, unless such Work is otherwise specifically mentioned for separate payment under another Bid Item. Payment shall only be made for those items included in the Proposal and all Work required by the Contract shall be included in those Bid Items.

Measurement and Payment shall be made in accordance with Section 1-04.6 for the following bid items:

Bid Item	Bid Item Name	Unit	Description, Measurement, and Payment
1	Temporary Erosion/ Water Pollution Control	LS	This work includes furnishing, installing, maintaining, removing and disposing of best management practices as defined in WAC 173-201A to manage erosion and water quality, and preparation of TESC and SWPPP plans, submittals, inspection and reporting, all in accordance with Section 31 25 14. It also includes excavation, embankment, Special borrow, crushed surfacing base course and HMA used in the temporary management of stormwater. The lump sum bid item will be paid in accordance with Section 1-09.9.
2	Surveying	LS	This work is described in Section 1-05.4. The lump sum bid item will be paid in accordance with Section 1-05.4 and Section 1-09.9.
3	Type B Schedule (Minimum Bid Amount $30,000.00)	LS	This work is described in Section 1-08.3. The lump sum bid item will be paid in accordance with Section 1-08.3.
4	Mobilization	LS	The work is described in Section 1-09.7. The lump sum bid item will be paid in accordance with Section 1-09.7.
5	Operation and Maintenance Manuals	LS	The work is described in Section 1-06.5. The lump sum bid item will be paid in accordance with Section 1-09.9.
6	Excavation Support Systems	LS	The work includes all measures required to comply with the Washington State Safety Code relating to excavation, trenching, and shoring: "Safety Standards for Construction Work," Chapter 296-155 WAC Part N and as described in Section 31 20 00. The lump sum bid item will be paid in accordance with Section 1-09.9.
7	Excavation Including Haul	CY	The work is described in Section 31 20 00. This bid item includes the initial excavation to bring the site generally to subgrade elevation and grading of stormwater ponds. It does not include excavation for foundations, retaining walls, utility trenches or utility structures/vaults. Any excavation required for temporary stormwater management, correction of improper temporary stormwater management, or temporary access is not included.

Bid Item	Bid Item Name	Unit	Description, Measurement, and Payment
			Only one determination of the original ground elevation will be made on this project based on the original ground elevation recorded previous to the award of this contract minus a depth of 8 inches to account for the removal of organic material during clearing and grubbing for the topsoil set aside. The Excavation quantity has been calculated as the in-situ volume of excavation between the adjusted original ground and the planned subgrade in pavement areas, stormwater ponds, and side slopes. Finished grades of buildings have been used as “subgrade” for calculation purposes. If discrepancies are discovered in the ground elevations which will materially affect the quantities of earthwork or additional excavation is required by the Engineer due to poor compactability of unsuitable native material, the original computations of excavation quantities will be adjusted accordingly and paid at the established unit price. Except in the case of discrepancies found or the work is modified as directed by the Engineer, the quantity paid will be as shown in the Bid Proposal. Electronic files in AutoCAD/Civil 3D format, including surfaces and features affecting the calculation, will be provided to the successful Bidder. The unit price bid item will be paid per cubic yard.
8	Embankment Compaction	CY	The work is described in Section 31 20 00. This bid item includes the initial embankment to bring the site generally to subgrade elevation and grading of stormwater ponds. It does not include backfill for foundations, retaining walls, utility trenches or utility structures/vaults. Any embankment required for temporary stormwater management, correction of improper temporary stormwater management, or temporary access is not included. Only one determination of the original ground elevation will be made on this project based on the original ground elevation recorded previous to the award of this contract minus a depth of 8 inches to account for the removal of organic material during clearing and grubbing for the topsoil set aside. The Embankment Compaction quantity has been calculated as the compacted volume of fill between the adjusted original ground and the

Bid Item	Bid Item Name	Unit	Description, Measurement, and Payment
			planned subgrade in pavement areas, stormwater ponds and side slopes. Finished grades of buildings have been used as “subgrade” for calculation purposes. If discrepancies are discovered in the ground elevations which will materially affect the quantities of fill or additional fill is required by the Engineer due to poor compactability of unsuitable native material, the original computations of embankment compaction quantities will be adjusted accordingly and paid at the established unit price. Except in the case of discrepancies found or the work is modified as directed by the Engineer, the quantity paid will be as shown in the Bid Proposal. Electronic files in AutoCAD/Civil 3D format, including surfaces and features affecting the calculation, will be provided to the successful Bidder. The unit price bid item will be paid per cubic yard
9	Special Borrow Including Haul	TN	The work is described in Section 31 20 00. Special borrow required for temporary stormwater management, correction of improper temporary stormwater management, or temporary access is not included. Special borrow will be measured by the ton of material actually placed in its permanent location as shown on the Plans. The unit price bid item will be paid by the ton.
10	Crushed Surfacing Base Course	TN	The work is described in Section 32 11 23. Crushed Surfacing Base Course required for temporary stormwater management, correction of improper temporary stormwater management, or temporary access is not included. Crushed Surfacing Base Course will be measured by the ton of material actually placed in its permanent location as shown on the Plans. The unit price bid item will be paid by the ton.
11	HMA Cl. ½ In PG 64-22	TN	The work is described in Section 32 12 16. HMA required for temporary stormwater management, correction of improper temporary stormwater management, or temporary access is not included. HMA will be measured by the ton of material actually placed in its permanent location as shown on the Plans.

Bid Item	Bid Item Name	Unit	Description, Measurement, and Payment
			The unit price bid item will be paid by the ton.
12	Site Improvements	LS	The work is described in Divisions 31, 32 and 33. The work includes all improvements not covered by other pay items. This includes, but is not limited to: • Clearing, grubbing, and disposal of debris • Sawcutting • Excavation, embankment, Special borrow, crushed surfacing base course and HMA used for temporary access • Excavation and embankment for foundations of structures or amenities included in this bid item, retaining walls, utility trenches or utility structures/vaults • Retaining walls, including base and drainage layers • Stormwater system including piping, catch basins, flow control structures, detention vault, biofiltration vault, hydrodynamic separator, oil separator, wetland pond access roads, pipe inlet and outlet protection • Watermain system, including water main piping, services, hydrants, and valves. • Onsite sewage system (OSS) • Underground containment vault • Irrigation system • Landscaping, including plantings, seeding, excavating for planting, trimming existing trees in conflict with proposed improvements • Excavating, stockpiling and placing native topsoil • Concrete cement paving, sidewalks, curb and gutter • Precast wheel stops, bollards, pavement striping, and signage • Chain link fencing and gates, automatic cantilever gates, automatic barrier gates • Rounded rail fencing • Monument sign • Flagpole system • Trash enclosures • Covered parking (including bridge crane)

Bid Item	Bid Item Name	Unit	Description, Measurement, and Payment
			• Covered and uncovered storage areas for equipment and bulk materials • Salt storage and brine maker/street sweepings structures • Sander insert rack • Vehicle wash system and wash bay structure • Generator system • Fuel station • Electric vehicle charging stations • Site plumbing as shown on the Plumbing Site Plan • Site fire protection system as shown on the Site Fire Protection Site Plan • Site electrical system as shown on the Electrical Site Plan • Site lighting system as shown on the Lighting Site Plan • Site technology system as shown on the Site Technology Site Plan • Miscellaneous items The lump sum bid item will be paid in accordance with Section 1-09.9.
13	Road Operations Facility Building	LS	The work includes construction of the Road Operations Facility (ROF) building including an approximately 17,900 SF tilt-up concrete structure with structural steel roofing, light gauge stud infill framing, embedded hydronic heating, and photovoltaic system, comprised of offices, storage, locker, washroom areas, and vehicle and equipment maintenance shop area. The work includes all work within the building footprint and envelope, including but not limited to excavation, embankment compaction, foundation, utility coordination and utility services, utilities within the building footprint and connections, building structure and envelope, mechanical, electrical and plumbing, and all miscellaneous elements to provide a fully operational and functioning road operations facility. The work also includes a 5-kilowatt Photo-voltaic system as described in Section 26 31 00. The lump sum bid item will be paid in accordance with Section 1-09.9.

Bid Item	Bid Item Name	Unit	Description, Measurement, and Payment
14	Household Hazardous Waste Collection Facility Building	LS	The work includes construction of the Household Hazardous Waste (HHW) Collection Facility, including an approximately 9,500 SF tilt-up concrete structure with structural steel roofing and light gauge stud infill framing, and embedded hydronic heating, comprised of areas for sorting, bulking, storage, reuse, offices, restrooms, and loading dock. The work includes all work within the building footprint and envelope including but not limited to excavation, embankment compaction, foundation, utility coordination and utility services, utilities within the building footprint and connections, building structure and envelope, mechanical, electrical and plumbing, and all miscellaneous elements to provide a fully operational and functioning hazardous waste facility. The lump sum bid item will be paid in accordance with Section 1-09.9.
15	Final Cleaning (Minimum Bid Amount $20,000.00)	LS	The work includes final cleanup and restoration of all paved and unpaved surfaces and areas disturbed by construction to conditions equal to, or better than existing and is also described in Section 1-05.11(1). The lump sum bid item will be paid in accordance with Section 1-09.9.
16	Minor Change	EST	This work is described in Section 1-04.4(1). The estimated bid item will be paid in accordance with Section 1-09.4.
17	Record Drawings (Minimum Bid Amount $30,000.00)	LS	This work is described in Section 1-05.18 The lump sum bid item will be paid in accordance with Section 1-05.18.
18	Photo-voltaic System – Added Capacity	LS	The work is described in Section 26 31 00 and includes increasing the capacity of the Photo-voltaic system to 99.5 kilowatts. The lump sum bid item will be paid in accordance with Section 1-09.9.

1-09.1 Measurement of Quantities

In measuring all acceptably completed Bid items of Work, the Engineer will:

1. Use United States standard measure;
2. Make all measurements as described in this section, unless individual Specifications require otherwise;

3. Follow methods generally recognized as conforming to good engineering practice;
4. Conform to the usual practice of the Contracting Agency by carrying measurements and computations to the proper significant figure or fraction of units for each item; and
5. Measure horizontally or vertically (unless otherwise specified).

The terms listed below shall be defined as follows in all measurements under this section:

"Lump Sum" (when used as an item of payment): complete payment for the Work described for that item in the Contract.

"Gauge" (in measurement of plates): the U.S. Standard Gauge.

"Gauge" (in measurement of galvanized sheets used to manufacture corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing): that specified in AASHTO M 36, M 167, M 196, M 197, or M 219.

"Gauge" (in measurement of wire): that specified in AASHTO M 32.

"Ton": 2,000 pounds of avoirdupois weight.

Items of payment that have "Lump Sum" or "Force Account" in the Bid item of Work shall have no specific unit of measurement requirement.

For each basis of measurement listed below, the Engineer will use the method of measurement described. For Bid items or materials measured on the basis of:

Hour – Measured for each hour that Work is actually performed. Portions of an hour will be rounded up to a half hour.

Square Yard or Square Foot – The measurement shall be a calculation from the neat dimensions shown in the Plans or as altered by the Engineer. If there is an exception within the measured area where the item of Work is not performed (such as a drainage vault within a measured sidewalk) and if the exception area is greater than 9 square feet, then the area of the exception will be subtracted from the payment area calculated from the neat dimensions.

Linear Foot – A length measured along an element unless the Plans require otherwise.

Weight – Weighed as required in Section 1-09.2.

Volume (of excavation and embankment) – Measured by the average-end-area method or by the finite element analysis method utilizing digital terrain modeling techniques. All or some computations may be based on ground elevations and other data derived photogrammetrically. The Engineer may correct for curvature.

Volume (in the hauling vehicle) – Measured at the point of delivery. Hauling vehicles may be of any size or type the Engineer approves provided that the body is of such shape that the actual contents may be readily and accurately determined. If the Engineer requires, the Contractor shall level loads at the delivery point to facilitate measurement.

For each item listed below, the Engineer will use the method of measurement described.

Structures – Measured on the neat lines shown in the Plans or as altered by the

Engineer. When a complete Structure or structural unit is specified as the unit of measurement, the unit shall include all fittings and accessories.

Timber – Measured by the thousand board feet (MBM) actually used in the Structure. Measurements will be based on nominal widths and thicknesses and the extreme length of each piece.

Standard Manufactured Items (fence, wire, plates, rolled shapes, pipe conduit, etc., when specified) – Measured by the manufacturer's identification of gage, unit weight, section dimension, etc. The Engineer will accept manufacturing tolerances set by each industry unless cited Specifications require more stringent tolerances.

Cement – Measured by the pound, ton, or sack. A sack shall be 94 pounds.

Asphalt – Measured by the gallon or ton. If measured by gallon, measurement will be made at 60 F (or will be corrected to the volume at 60 F in keeping with ASTM D1250). If shipped by rail, truck, or transport, measurement will be by net certified scale masses or certified volumes (corrected for material lost en route or not actually incorporated into the Work).

No measurement will be made for:

1. Work performed or materials placed outside lines shown in the Plans or set by the Engineer;
2. Materials wasted, used, or disposed of in a manner contrary to the Contract;
3. Rejected materials (including those rejected after placement if the rejection resulted from the Contractor's failure to comply with the Contract);
4. Hauling and disposing of rejected materials;
5. Material remaining on hand after the Work is completed, except as provided in Sections 1-09.5 and 1-09.10; or
6. Other Work or material contrary to the Contract Provisions.

1-09.2 Weighing Equipment

1-09.2(1) General Requirements for Weighing Equipment

Unless specified otherwise, all construction materials to be proportioned or measured and paid for by weight shall be weighed on a scale.

Scales – Scales shall:

1. Be accurate to within 0.5 percent of the correct weight throughout the range of use;
2. Not include spring balances;
3. Include beams, dials, or other reliable readout equipment;
4. Be built to prevent scale parts from binding, vibrating, or being displaced and to protect all working parts from falling material, wind, and weather; and
5. Be carefully maintained, with bunkers and platforms kept clear of accumulated materials that could cause errors and with knife edges given extra care and protection.

Scale Operations – "Contractor-provided scale operations" are defined as operations where a scale is set up by the Contractor specifically for the project and most, if not all,

material weighed on the scale is utilized for Contract Work. In this situation, the Contractor shall provide a person to operate the project scale, generate E-tickets, perform scale checks and prepare reports.

“Commercial scale operations” include the use of established scales used to sell materials to the public on a regular basis. In addition, for the purposes of this Specification, all batch, hopper, and belt scales are considered to be commercial scales. When a commercial scale is used as the project scale, the Contractor may utilize a commercial scale operator provided it is at no additional cost to the Contracting Agency.

In addition, the Contractor shall ensure that:

1. The Engineer is allowed to observe the weighing operation and check the daily scale weight record;
2. Scale verification checks are performed at the direction of the Contracting Agency (see Section 1-09.2(5));
3. Several times each day, the scale operator records and makes certain the platform scale balances and returns to zero when the load is removed; and
4. Test results and scale weight records for each day’s hauling operations are provided to the Engineer daily. Reporting shall utilize WSDOT form 422-027, Scaleman’s Daily Report, unless the printed ticket contains the same information that is on the Scaleman’s Daily Report Form. The scale operator must provide AM and/or PM tare weights for each truck on the printed ticket.

Trucks and E-Tickets – Each truck to be weighed shall bear a unique identification number. This number shall be legible and in plain view of the scale operator. The Contracting Agency will provide item quantity tickets for scales that are not self-printing. The Contractor shall provide E-tickets for all weighed materials. All E-tickets shall, at a minimum, contain the following information:

1. Date of haul;
2. Contract number;
3. Contract unit Bid item;
4. Unit of measure;
5. Identification number of hauling vehicle; and
6. Weight delivered:
    a. Net weight in the case of batch and hopper scales.
    b. Gross weight, tare (a.m. and p.m. minimum) and net weight in the case of platform scales (tare may be omitted if a tare beam is used).
    c. Approximate load out weight in the case of belt conveyor scales.

E-tickets shall be uploaded to the designated site so that they can be accessed by the material receiver at the material delivery point. The material delivery point is defined as the location where the material is incorporated into the permanent Work. The Contractor’s representative shall make report summaries available to the Engineer’s designated receiver, not later than the end of shift, for reconciliation. E-tickets for loads not verified as delivered will receive no pay.

1-09.2(1)A Electronic Delivery Management System (E-Ticketing)

No fewer than 30 days prior to delivery or placement activities, the Contractor shall submit a Type 2 Working Drawing to the Engineer detailing all E-Ticketing Systems (ETS) used to provide the required information. It is recognized that multiple systems may be used to accommodate individual Contractors and Material supplier capabilities. The Working Drawings shall explain how partial loads will be tracked, and include contingency plans for lost internet connectivity and/or phone reception. The Contractor shall provide on-site technical assistance and training during the initial setup to all parties requiring access to the e-ticket information. The Contractor shall provide ETS support as necessary during the Work to ensure effective ongoing utilization.

1-09.2(1)A1 Equipment

The Contractor shall demonstrate that the ETS can provide the following:

1. The ETS shall be fully integrated with the Contractor's Load Read-Out scale system at the material source site. In the absence of a fully integrated system, digital data can be captured by a photo of the ticket (pdf ticket) generated at the scale at load out. The information shall be immediately uploaded to a designated site so the information can be accessed by the Inspector located at the material delivery site.
2. The ETS shall be accessible by real-time monitoring with a mobile communication device such as a tablet or smartphone.

The Material Source site (point of load out) shall have a reliable, stable internet connection, with a local Wi-Fi device (hot spot) in areas with poor or no cell service.

The Contractor shall install and operate equipment in accordance with their accepted ETS. The Type 2 Working Drawing shall identify an alternative method for manually capturing and electronically delivering data if internet access and/or cell phone service is temporarily unavailable at the load out site.

1-09.2(1)A2 E-Tickets

The E-Tickets must provide, at a minimum, the information required in Section 1-09.2(1) for truck weight measurement and Section 6-02.3(5)B for concrete delivery.

1-09.2(1)A3 Daily Summary Report

The Contractor shall provide to the Engineer a means in which to gather report summaries using mobile communication devices. The following summary of information shall be provided to the Engineer electronically, in a file format that cannot be edited, at the end of the days hauling operation or as agreed to by the Project Engineer. The summary report shall include:

1. For each Material:
    a. List of Individual Loads including:
        i. Contractor Name and Material Producer
        ii. Project Number and County
        iii. Truck Number
        iv. Net Weight for Payment (nearest 0.1 tons) or volume for payment
        v. Date Placed

vi. Time Loaded

2. For each Bid Item:
   a. Total Quantity for Payment (weight or volume)

1-09.2(2) Specific Requirements for Batching Scales

Each batching scale shall be designed to support a weighing container. The arrangement shall make it convenient for the operator to remove material from the weighing container while watching readout devices. A weighing container mounted on a platform scale shall have its center of gravity directly over the platform centerline. Batching scales used for concrete or hot mix asphalt shall not be used for batching other materials.

Readout devices used for batching or hopper scales shall be marked at intervals evenly spaced throughout and shall be based on the scale's nominal rated capacity. These intervals shall not exceed one-tenth of 1 percent of the nominal rated capacity. Before use at a new site and then at 6-month intervals, all batching and hopper scales shall be: approved under rules of the Weights and Measures Section of the Washington State Department of Agriculture or serviced and tested with at least 10,000 pounds by an agent of its manufacturer. In each case, the Contractor shall provide the Engineer with a copy of the final test results.

1-09.2(3) Specific Requirements for Platform Scales

Each platform scale shall be able to weigh the entire hauling vehicle or combination of connected vehicles at one time. No part of the vehicle or vehicle combination will be permitted off the platform as it is weighed. A tare weight shall be taken of each hauling vehicle at least once daily.

Platform scales shall be installed and maintained with the platform level and with rigid bulkheads at each end to prevent binding or shifting. The readout device shall be marked at intervals of no more than 40 pounds. Test records shall show results to the nearest 20 pounds. During weighing operations, weights shall be read and recorded to the nearest 100 pounds. Before use at a new site and then at 6-month intervals, platform scales shall be: approved under rules of the Washington State Department of Agriculture's Weights and Measures Section, or serviced and tested with at least 10,000 pounds by an agent of its manufacturer. In each case, the Contractor shall provide the Engineer with a copy of the final test results.

1-09.2(4) Specific Requirements for Belt Conveyor Scales

The Engineer may approve conveyor-belt weighing of untreated materials if the method and device meet all general requirements for weighing equipment. The recording tape, odometer, totalizer, calibration adjustment, and clock-time imprinter shall be kept locked and the Engineer shall retain all keys. All belt-conveyor scales shall comply with the requirements for Belt-Conveyor Scales in the National Institute of Standards and Technology (NIST) Handbook No. 44, except where these Specifications modify those requirements.

A static load test shall be made: each day after the belt-conveyor has run continuously for about 30 minutes, and again, immediately after the air temperature changes significantly. If the static load test reveals a need for adjustment, the Contractor shall

perform a chain test. The Contractor shall make the computation of the test chain calibration, the calibration procedures and results, and related records available for the Engineer's review. The test chain shall be clearly marked with its calibration, carried in a suitable container, and kept immediately available for testing.

1-09.2(5) Measurement

Scale Verification Checks – At the Engineer's discretion, the Engineer may perform verification checks on the accuracy of each batch, hopper, or platform scale used in weighing contract items of Work.

Verification checks may not be routinely conducted for weighed material, whose proposal quantity multiplied by the unit Bid price, has a value less than $20,000.

The verification will consist of one of the following methods and be at the Contractor's option:

1. Weigh a loaded truck on a separate certified platform scale designated by the Contractor, for the purpose of scale verification.
2. Weigh a vehicle that weighs at least 10,000 pounds on a separate certified scale and then check the project scale with it.
3. Establish a certified fixed load weighing at least 10,000 pounds as a check-weight. The certification shall consist of an affidavit affirming the correct weight of the fixed load.

Should the scale verification check reveal a weight difference of more than 0.5 percent, a second scale verification check shall be performed immediately. If the weight differences of both comparison checks exceed the 0.5-percent limit and the scale has been overweighing, the Contractor shall immediately stop weighing and the scale shall be recertified at the Contractor's expense. If the weight difference of both comparison checks exceed the 0.5 percent limit and the scale is underweighing, it shall be adjusted immediately. Contractor will not be compensated for resulting losses from under weighing.

Belt Scales – To test the accuracy of a belt-conveyor scale, the Contractor shall weigh five or more payloads from sequential hauling units and compare these weights with weights of the same payloads taken on a separate certified platform scale. If the test results fluctuate, the Engineer may require more than five check loads. Conveyor weights will be based on tonnage values taken from the sealed odometer at the beginning and end of each check period.

If scale verification checks show the scale has been under weighing, it shall be adjusted immediately. The Contractor shall not be compensated for resulting losses from under weighing.

If scale verification checks show the scale has been overweighing, its operation will cease immediately until adjusted.

1-09.2(6) Payment

Unless specified otherwise, the Contracting Agency will pay for no materials received by weight unless they have been weighed as required in this section or as required by another method the Engineer has approved in writing.

The Contractor shall not be compensated for resulting losses from under weighing that is revealed by scale verification checks.

If scale verification checks reveal that the scale is overweighing, then payment for all material weighed since the last valid scale verification check will be adjusted. The Contracting Agency will calculate the combined weight of all materials weighed after the last verification check showing accurate results. This combined weight will then be reduced for payment by the percentage of scale error that exceeds 0.5 percent unless the Contractor demonstrates to the satisfaction of the Engineer that the defect in the scale was present for a lesser period of time.

Unit Contract prices for the various pay items of the project cover all costs related to weighing and proportioning materials for payment. These costs include but are not limited to:

1. Furnishing, installing, certifying, and maintaining scales;
2. Providing a weigher to operate a Contractor-provided scale;
3. Providing a weigher to operate a commercial scale, if necessary;
4. Providing self-printing tickets, if necessary;
5. Rerouting a truck for verification weighing;
6. Assisting the Engineer with scale verification checks;
7. Other costs associated with meeting the requirements of this section.

All costs to comply with this Section, unless otherwise stated, are incidental to the Contract and are the responsibility of the Contractor. The Contractor shall include all related costs in the Bid prices of the Contract.

1-09.3 Scope of Payment

The payment provided for in the Contract shall be full payment to the Contractor for:

1. Furnishing all materials and performing all Work under the Contract (including changes in the work, materials, or Plans) in a complete and acceptable manner;
2. All risk, loss, damage, or expense of whatever character arising out of the nature or prosecution of the work; and
3. All expense incurred resulting from a suspension or discontinuance of the Work as specified under the Contract.

The payment of an estimate or retained percentage shall not relieve the Contractor of the obligation to correct defective Work or materials.

Unless the Plans and these Special Provisions provide otherwise, the unit Contract prices for the various Bids items shall be full payment for all labor, materials, supplies, equipment, tools, and all other things required to completely incorporate the item into the Work as though the item were to read “In Place.”

If the “Payment” clause in the Special Provisions, for an item included in the Proposal, covers and considers all Work and material essential to that item, then the Work or materials will not be measured or paid for under any other item that may appear elsewhere in the Proposal or Specifications.

1-09.4 Equitable Adjustment

The equitable adjustment provided for elsewhere in the Contract shall be determined in one or more of the following ways:

1. If the parties are able to agree, the price will be determined by using:
   a. Unit prices; or
   b. Other agreed upon prices;
2. If the parties cannot agree, the price will be determined by the Engineer using:
   a. Unit prices; or
   b. Other means to establish costs.

The following limitations shall apply in determining the amount of the equitable adjustment:

1. The equipment rates shall be actual cost but shall not exceed the rates set forth in the AGC/WSDOT Equipment Rental Agreement in effect at the time the Work is performed as referred to in Section 1-09.6, and
2. To the extent that delay or failure of performance was concurrently caused by the Contracting Agency and the Contractor, the Contractor shall be entitled to a time extension for the portion of the delay or failure of performance concurrently caused, provided the Contractor makes such a request pursuant to Section 1-08.8; however, the Contractor shall not be entitled to an adjustment in Contract price.
3. No claim for anticipated profits on deleted, terminated, or uncompleted Work will be allowed.
4. No claim for consequential damages of any kind will be allowed.

1-09.5 Deleted or Terminated Work

The Engineer may delete Work by change order as provided in Section 1-04.4 or may terminate the Contract in whole or part as provided in Section 1-08.10(2). When the Contract is terminated in part, the partial termination shall be treated as a deletion change order for payment purposes under this section.

Payment for completed items will be at unit Contract prices.

When an item is deleted in whole or in part by change order or when the Contract is terminated in whole or in part, payment for deleted or terminated Work will be made as follows:

1. Payment will be made for the actual number of units of Work completed at the unit Contract prices unless the Engineer determines the unit prices are inappropriate for the Work actually performed. When that determination is made by the Engineer, payment for Work performed will be as mutually agreed. If the parties cannot agree the Engineer will determine the amount of the equitable adjustment in accordance with Section 1-09.4;
2. Payment for partially completed lump sum items will be as mutually agreed. If the parties cannot agree, the Engineer will determine the amount of the equitable adjustment in accordance with Section 1-09.4;
3. To the extent not paid for by the Contract prices for the completed units of Work, the

Contracting Agency will pay as part of the equitable adjustment those direct costs necessarily and actually incurred by the Contractor in anticipation of performing the Work that has been deleted or terminated;

4. The total payment for an item in the case of a deletion or partial termination shall not exceed the Bid price as modified by approved change orders less the estimated cost (including overhead and profit) to complete the Work and less amounts paid to the Contractor for the item;
5. The total payment where the Contract is terminated in its entirety shall not exceed the total Contract price as modified by approved change orders less those amounts paid to the Contractor before the effective date of the termination; and
6. No claim for damages of any kind or for loss of anticipated profits on deleted or terminated Work will be allowed because of the termination or change order.

Contract time shall be adjusted as the parties agree. If the parties cannot agree, the Engineer will determine the equitable adjustment for Contract time.

Acceptable materials ordered by the Contractor prior to the date the Work was terminated as provided in Section 1-08.10(2) or deleted as provided in Section 1-04.4 by the Engineer, will either be purchased from the Contractor by the Contracting Agency at the actual cost and shall become the property of the Contracting Agency, or the Contracting Agency will reimburse the Contractor for the actual costs connected with returning these materials to the suppliers.

1-09.6 Force Account

The Contracting Agency has estimated and included in the Proposal, dollar amounts for all items to be paid per force account, only to provide a common proposal for Bidders. All such dollar amounts are to become a part of Contractor's total bid. However, the Contracting Agency does not warrant expressly or by implication, that the actual amount of work will correspond with those estimates. Payment will be made on the basis of the amount of work actually authorized by Engineer.

The terms of the Contract or of a change order may call for Work or material to be paid for by force account. If so, then the objective of this Specification is to reimburse the Contractor for all costs associated with the Work, including costs of labor, small tools, supplies, equipment, specialized services, materials, applicable taxes and overhead and to include a profit commensurate with those costs. The amount to be paid shall be determined as described in this section.

1. **For Labor –** Labor reimbursement calculations shall be based on a “Project Labor List” (List) prepared and submitted by the Contractor and by any subcontractors before Force Account work begins. Once a List is approved by the Engineer, it shall be used to calculate force account labor payment until a new List is submitted and approved. The Engineer may compare the List to payrolls and other documents and may, at any time, require the Contractor to submit a new List. The Contractor may submit a new List at any time without such a requirement. Prior payment calculations shall not be adjusted as a result of a new List.

   To be approved, the List must be accurate and meet the requirements of this section. It shall include regular time and overtime rates for all employees (or work

classifications) expected to participate in force account Work. The rates shall include the basic wage and fringe benefits, the current rates for Federal Insurance Compensation Act (FICA), Federal Unemployment Tax Act (FUTA) and State Unemployment Tax Act (SUTA), the company's present rates for Medical Aid and Industrial Insurance premiums and the planned payments for travel and per diem compensation.

In the event that an acceptable initial List or requested revised List is not received by the time that force account calculations are begun, the Engineer will develop a List unilaterally, utilizing the best data available, that will be used until a Contractor's List is received and approved. Again, prior calculations, prepared using the Engineer's List, will not be revised as a result of differences with the Contractor's List.

In addition to compensation for direct labor costs defined above, the Contracting Agency will pay Contractor 29 percent of the sum of the costs calculated for labor reimbursement to cover project overhead, general company overhead, profit, bonding, insurance required by Sections 1-07.10 and 1-07.18, Business & Occupation tax, and other costs incurred, except paid sick leave. The Contracting Agency will pay the Contractor an additional 2 percent of the sum of the costs calculated for labor reimbursement to cover the cost of paid sick leave. This amount will include all costs of safety training and health tests, but will not include such costs for unique force account Work that is different from typical Work and which could not have been anticipated at time of Bid.

2. **For Materials –** The Contracting Agency will reimburse invoice cost for materials. For the purpose of this provision, "Materials" shall include those items incorporated into the Work, supplies used during the Work and items consumed. This cost shall include freight and handling charges and applicable taxes. Before Work is started, the Engineer may require the Contractor to obtain multiple quotations for the materials to be utilized and select the vendor with prices and terms most advantageous to the Contracting Agency.

   The Contracting Agency will provide a list of the types and quantities of materials witnessed by the Contracting Agency as being utilized in force account Work. The list will be furnished promptly after the material is incorporated, on a daily basis unless agreed otherwise. The Contractor may propose corrections to the list and will supply prices for the materials and other costs and return the list to the Contracting Agency. To support the prices, the Contractor shall attach valid copies of vendor invoices. If invoices are not available for materials from the Contractor's stocks, the Contractor shall certify actual costs by affidavit. The Engineer will review the prices and Contractor-proposed corrections and, if reasonable, approve the completed list. Once approved, the prices will be utilized in the calculation of force account reimbursement for materials.

   If, in the case of non-invoiced materials supported by Contractor affidavit, the price appears to be unreasonable, the Engineer will determine the cost for all or part of those materials, utilizing the best data available.

   The Contracting Agency reserves the right to provide materials. In this case, the Contractor will receive no payment for additional costs, overhead, or profit arising from the value of the materials themselves. Labor and equipment necessary for

handling and placing the Agency-furnished material will be compensated as described in this Specification.

In addition to compensation for direct materials cost, the Contracting Agency will pay the Contractor 21 percent of the sum of the costs calculated for materials reimbursement to cover project overhead, general company overhead, profit, bonding, insurance, required by Sections 1-07.10 and 1-07.18, Business & Occupation tax, and all other costs incurred.

3. **For Equipment –** The Contracting Agency will reimburse the Contractor for the cost of equipment utilized in the Work. The equipment provided by the Contractor shall be of modern design and in good working condition. For the purpose of this provision, "provided" shall mean that the equipment is owned (either through outright ownership or through a long-term lease) and operated by the Contractor or subcontractor or that the equipment is rented and operated by the Contractor or subcontractor. Equipment that is rented with operator shall not be included here, but shall be considered a service and addressed according to Subsection 4 of this provision.

   The amount of payment for Contractor-owned equipment that is utilized shall be determined according to the version of the AGC/WSDOT Equipment Rental Agreement which is in effect at the time the force account is authorized. The rates listed in the Rental Rate Blue Book (as modified by the current AGC/WSDOT Equipment Rental Agreement) shall be full compensation for all fuel, oil, lubrication, ordinary repairs, maintenance, and all other costs incidental to furnishing and operating the equipment except labor for operation.

   Payment for rented equipment will be made on the basis of a valid invoice, covering the time period of the Work. Before Work is started, the Engineer may require the Contractor to obtain multiple quotations for the rental of equipment to be utilized and select the vendor with prices and terms most advantageous to the Contracting Agency. In the event that prior quotations are not obtained and the vendor is not a firm independent from the Contractor or subcontractor, then after-the-fact quotations may be obtained by the Engineer from the open market in the vicinity and the lowest such quotation may be used in place of submitted invoice.

   In addition to the payments for Contractor-owned and rented equipment, one or more lump-sum payments may be made for small tools. The amount to be paid shall be determined as outlined in the AGC/WSDOT Equipment Rental Agreement.

   The Contracting Agency will add 21 percent to equipment costs to cover project overhead, general company overhead, profit, bonding, insurance, required by Sections 1-07.10 and 1-07.18, Business & Occupation tax, and all other costs incurred. This markup will be over and above those equipment costs and will not be adjusted for equipment overhead amounts included in the Blue Book rates.

   Copies of the AGC/WSDOT Equipment Rental Agreement will be maintained on the Contracting Agency's website at https://wsdot.wa.gov/publications/fulltext/construction/equipment-rental-agreement.pdf.

4. **For Services –** Compensation under force account for specialized services shall be made on the basis of an invoice from the providing entity. A "specialized service" is a

work operation that is not typically done by worker classifications as defined by the Washington State Department of Labor and Industries and by the Davis Bacon Act, and therefore bills by invoice for work in road, bridge and municipal construction. Before Work is started, the Engineer may require the Contractor to obtain multiple quotations for the service to be utilized and select the provider with prices and terms most advantageous to the Contracting Agency. In the event that prior quotations are not obtained and the service invoice is submitted by a subcontractor, then after-the-fact quotations may be obtained by the Engineer from the open market in the vicinity and the lowest such quotation may be used in place of the submitted invoice.

The Contracting Agency will pay the Contractor an additional 21 percent of the sum of the costs included on invoices for specialized services to cover project overhead, general company overhead, profit, bonding, insurance, required by Sections 1-07.10 and 1-07.18, Business & Occupation tax, and all other costs incurred.

When a supplier of services is compensated through invoice, but acts in the manner of a Subcontractor, as described in Subsection 6 of this provision, then markup for that invoice shall be according to Subsection 6, “Contractor Markup on Subcontractors’ Work”.

5. **For Mobilization –** Force account mobilization is defined as the preparatory Work performed by the Contractor including procurement, loading and transportation of tools and equipment, and personal travel time (when such travel time is a contractual obligation of the Contractor or a customary payment for the Contractor to all employees). Mobilization also includes the costs incurred during demobilization. Pro-rata adjustments may be made when the mobilization applies to both force account and other Contract Work. The Contracting Agency will pay for mobilization for off-site preparatory Work for force account items provided that notice has been provided sufficiently in advance to allow the Engineer to witness the activity, if desired.

   All costs experienced during mobilization activities for labor, equipment, materials or services shall be listed in those sections of the force account summary and paid accordingly.

6. **For Markup on Subcontractor’s Work –** When Work is performed on a force account basis by approved first-tier subcontractors, or suppliers, or through invoice by firm(s) acting in the manner of a subcontractor, the Contractor will be allowed an additional markup, from the table below, applied to the costs computed for Work done by each subcontractor through Subsections 1, 2, 3, and 4, to compensate for all administrative costs, including project overhead, general company overhead, profit, bonding, insurance required by Sections 1-07.10 and 1-07.18, Business & Occupation tax, and all other costs incurred.

   A firm may be considered to be acting as a subcontractor when the Engineer observes one or more of the following characteristics:

   a. The person in charge of the firm’s activities takes an active role in managing the overall project, including extensive coordination, interpretation of Plans, interaction with the Contracting Agency or management of a complex and interrelated operation.

b. Rented equipment is provided fueled, operated and maintained by the firm. Operators of rented equipment are supervised directly by the firm's representative. There is little interaction between the Contractor and the employees of the firm.

c. The firm appears to be holding the risk of performance and quality of the Work.

d. The firm appears to be responsible for liability arising from the Work.

Markups on Work Performed by Subcontractor(s):

(1) On amounts paid for Work performed by each subcontractor on each force account and calculated through Subsections 1-4,	up to $25,000	12 percent
(2) On amounts greater than	$25,000 up to $100,000	10 percent
(3) On amounts greater than	$100,000	7 percent

The amounts and markup rates shall be calculated separately for each first-tier subcontractor on each force account item established.

The payments provided above shall be full payment for all Work done on a force account basis. The calculated payment shall cover all expenses of every nature, kind, and description, including those listed above and all others incurred on the Work being paid through force account. Nothing in this provision shall preclude the Contractor from seeking an extension of time or time-related damages to unchanged Work arising as a result of the force account Work. The amount and costs of all Work to be paid by force account shall be computed by the Engineer, and the result shall be final as provided in Section 1-05.1.

An item that has been Bid at a unit price or lump sum in the Proposal will not be paid as force account unless:

1. A change as defined in Section 1-04.4 has occurred and the provisions require a payment adjustment.
2. A Contract item paid by force account requires Work that is normally included in a lump sum Contract item. In such a case, the Work normally included in a lump sum Contract item will be paid by force account under the force account Contract item.

Items that are included in the Proposal as Force Account or that are added by change order as Force Account may, by agreement of the parties at any time, shall be converted to agreed unit prices or lump sums applicable to the remaining Work.

1-09.7 Mobilization

Mobilization consists of preconstruction expenses and the costs of preparatory Work and operations performed by the Contractor typically occurring before 10 percent of the total original Contract amount is earned from other Contract items. Items which are not to be included in the item of Mobilization include but are not limited to:

1. Portions of the Work covered by the specific Contract item or incidental Work which is to be included in a Contract item or items.
2. Profit, interest on borrowed money, overhead, or management costs.
3. Costs incurred for mobilizing equipment to perform force account Work.

Based on the lump sum Contract price for "Mobilization," partial payments will be made

as follows:

1. When the Field Office Building is installed and functional, and the Preconstruction Work Phase as described in Section 1-08.4 is complete, 10 percent of the amount Bid for mobilization, or 1 percent of the total original Contract amount, whichever is least, will be paid.
2. When 5 percent of the total original Contract amount is earned from other Contract items, excluding amounts paid for materials on hand, 50 percent of the amount Bid for mobilization, or 5 percent of the total original Contract amount, whichever is the least, will be paid.
3. When 10 percent of the total original Contract amount is earned from other Contract items, excluding amounts paid for materials on hand, 100 percent of the amount Bid for mobilization, or 10 percent of the total original Contract amount, whichever is the least, will be paid.
4. When the Substantial Completion Date has been established for the project, payment for mobilization in excess of 10 percent of the total original Contract amount, if any, will be paid.

Nothing herein shall be construed to limit or preclude partial payments otherwise provided by the Contract.

1-09.7(1) Field Office Building

This work shall consist of furnishing and setting up a temporary office building for the sole use of the Contracting Agency.

The Contractor shall provide a field office on or adjacent to the project site for the use of the Engineer's staff within fifteen (15) calendar days after the Notice to Proceed. The field office details and its location shall be subject to the approval of the Engineer and shall be submitted no later than the pre-construction meeting. The field office building shall meet the following requirements: Weather-tight construction; portable structure minimum width of 10 feet, and not less than 440 square feet of clear floor space, two private offices, indoor restroom, two doors, minimum window area of 40 square feet with bug screens, and interior wall surfaces suitable for displaying construction plans. Window and door glass shall be protected with heavy security screens on metal frames bolted to the walls or doors. At a minimum, each door shall have one deadbolt cylinder lock, with six keys for each lock.

The field office shall be placed level and firmly supported on blocks. Steps shall be supplied for each door, and if more than three steps are required, a floor-level landing of at least 12 square feet with railing shall be provided. Steps and landing shall be stable and slip resistant. A three-sided boot brush shall be provided at each door.

Space to park a minimum of two pickups shall be provided.

The Contractor shall be responsible for maintaining and cleaning the field office; repairing any damage to the structure, equipment and appurtenances; providing outside janitorial services including supplying appropriate toilet room paper products; refilling applicable dispensers with drinking water cups, and paper towels; cleaning windows and sweeping floors; and emptying trash receptacles and recyclables, disposing trash, and relining trash receptacles and recyclables.

The office shall be furnished with the following furniture, equipment and appurtenances reasonably presentable, in good working order, and acceptable to the Engineer:

1. Executive chair (two), each with seat cushion, adjustable height seat, tilt back, arm rests, and floor wheels,
2. Office desk (Four), 30” x 60” minimum size, with at least 4 drawers which can be locked with key & one of which is set up for file folders, 2 sets of keys each desk,
3. Office table 36” x 72” (two), 1 Conference table 4’ x 10’,
4. Office chairs with seat & back cushion (twelve),
5. White board (3’H x4’W) with dry erase markers and 1 white board eraser,
6. Drinking water with disposable cup dispenser filled with cups,
7. Trash receptacles and recycle bins,
8. Heating and air-conditioning of sufficient capacity to heat to keep the office temperature between 68°F and 76°F during hours of operation,
9. Color Photocopy/Color Printer/Color Scanner/Fax multifunction machine with multiple tray frontload including 3 paper trays (8-1/2 x 11-inch, 8-1/2 x 14-inch, and 11 x 17 inch) with the following:
    a. Under storage cabinet, floor wheels to accommodate service technician.
    b. Preset reduction to 50% and enlarge to 200% plus zoom in 1% increments.
    c. Bypass tray
    d. Replacement toner cartridge (1 cartridge for each color)
    e. Capability to scan directly to PDF color at 300 dpi
    f. Plain paper fax capable
    g. Direct phone line connection and programmable capable to directly send scanned documents and faxes by e-mail.
    h. 400 sheets of each size 20 lb. bright paper with no more than 30% recycle post-consumer content.
    i. Repair and maintenance service contract with 4-hour service response on-site parts and labor;

The Contractor shall provide a commercial grade broadband internet access with a static IP address (Cable or DSL at a minimum speed of 2.0 Mbps upload & 6.0 Mbps download) between the field office and an Internet Service Provider (ISP). The Contractor shall provide for 24-hour technical support and a local or 1-800 phone number to troubleshoot and maintain the broadband connectivity. The Contractor shall provide inside wiring to support a Local Area Network inside the field office and shall include a 4-plex jack to at least 5 workstations (desk or table locations to be addressed at the pre-construction meeting per Section 1-08.1(2)).

The Contractor shall provide necessary equipment to allow internet connectivity and shall be configured to allow VPN access from individual machines to the Contracting Agency. Color Printer/Color Copier/Scanner/Fax multifunction machine shall be connected to the office network and programmed to send scanned documents by e-mail.

Electric power of sufficient capacity to operate an electric heater, air conditioner, mini-refrigerator, microwave oven and other required equipment. After obtaining inspection and approval of the field office electrical system and the proposed temporary power connection hook-up from County, the Contractor shall provide a minimum 15 Calendar Days advance notice to the local power utility requesting a temporary power drop and connection. Generators (gas and diesel) for producing electrical power will not be allowed unless the Engineer permits such in writing.

If the Contractor fails to provide a field office at the location on the date agreed to at the pre-construction meeting, the Engineer will provide Written Notice of such and shall have the right to withhold progress payments in accordance with Section 1-09.9(3). If within five (5) Calendar Days of delivery of such notice the Contractor has not provided the field office, then the Engineer will have the option to provide the field office. If the Engineer elects to provide the field office, the Engineer will give the Contractor a second Written Notice of such; will within three (3) Calendar Days of delivery of the second Written Notice provide the field office meeting the requirements specified in this Section and will charge the Contractor by deducting from monies due or to become due the Contractor on progress payments, all costs associated with the field office as specified in this Section. Upon deliverance of the second Written Notice, the Contractor's right to provide the field office shall be forfeited.

The field office, equipment, and appurtenances supplied by the Contractor shall revert to and be removed by the Contractor when the Engineer, via the Written Notice of Physical Completion to the Contractor, establishes the Physical Completion Date. If the Contractor removes, closes, or discontinues the services specified in this Section prior to receiving the Written Notice of Physical Completion without first obtaining approval from the Engineer, the Contractor responsible for all cost of relocation of County staff and cost associated with acquiring a replacement office.

All costs to procure and install the field office building, furnishings and appurtenances, costs for the work required to provide and maintain the field office including regular expenses for telephone, internet, electricity, etc.; incidental constructions to accommodate; and to procure all permits and licenses required for the field office to meet the requirements of this Section, relocation of the field office if needed, and removal shall be included in the lump sum Contract price for "Mobilization."

The monthly telephone costs will be paid by the Contracting Agency.

1-09.8 Payment for Material on Hand

The Contracting Agency may reimburse the Contractor for materials purchased before their use in the Work if they:

1. Meet the requirements of the Plans and Specifications;
2. Are delivered to or stockpiled near the project or other Engineer-approved storage sites; and
3. Consist of: sand, gravel, surfacing materials, aggregates, reinforcing steel, bronze plates, structural steel, machinery, piling, timber and lumber (not including forms or falsework), large signs unique to the project, prestressed concrete beams or girders, or other materials the Engineer may approve.

The Contracting Agency may reimburse the Contractor for traffic signal controllers as follows:

1. Fifty percent when the traffic signal controller and all components are received and assembled into a complete unit at the State Materials Laboratory.
2. One hundred percent when the traffic signal controller is approved for shipment to the project by the State Materials Laboratory.

The Contractor shall provide sufficient written evidence of production costs to enable the Engineer to compute the cost of Contractor-produced materials (such as sand, gravel, surfacing material, or aggregates). For other materials, the Contractor shall provide invoices from material suppliers. Each invoice shall be detailed sufficiently to enable the Engineer to determine the actual costs. Payment for materials on hand shall not exceed the total Contract cost for the Contract item.

If payment for material on hand is based upon an unpaid invoice, the Contractor shall provide the Engineer with a paid invoice within 60 calendar days after the Contracting Agency's payment. If the paid invoice is not furnished within this time, the payment amount will be deducted from the next progress estimate and withheld until the paid invoice is supplied.

The Contracting Agency will not pay for material on hand when the invoice cost is less than $2,000. As materials are used in the Work, credits equaling the partial payments for them will be taken on future estimates. Partial payment for materials on hand shall not constitute acceptance. Materials will be rejected if found to be defective, even if partial payment for it has been made.

1-09.9 Payments

The basis of payment will be the actual quantities of Work performed according to the Contract and as specified for payment.

The Contractor shall submit a Schedule of Values including a breakdown of the cost of lump sum bid items at the Preconstruction Conference, to enable the Project Engineer to determine the Work performed on a monthly basis.

Progress payments for completed work and material on hand will be based upon progress estimates prepared by the Contractor and reviewed by the Engineer. A progress estimate cutoff date will be established at the preconstruction conference.

The initial progress estimate will be made not later than 30 days after the Contractor commences the work, and successive progress estimates will be made every month thereafter until the Completion Date. Progress estimates made during progress of the work are tentative, and made only for the purpose of determining progress payments. The progress estimates are subject to change at any time prior to the calculation of the final payment.

The value of the progress estimate will be the sum of the following:

1. Unit Price Items in the Bid Form — the approximate quantity of acceptable units of work completed multiplied by the unit price.

2. Lump Sum Items in the Bid Form — based on the approved Contractor's lump sum breakdown for that item, or absent such a breakdown, based on the Engineer's determination.
3. Materials on Hand — 100 percent of invoiced cost of material delivered to Job site or other storage area approved by the Engineer.

Progress payments will be made in accordance with the progress estimate less:

1. Retainage per Section 1-09.9(1)
2. The amount of progress payments previously made; and
3. Funds withheld by the Contracting Agency for disbursement in accordance with the Contract Documents.

Progress payments for work performed shall not be evidence of acceptable performance or an admission by the Contracting Agency that any work has been satisfactorily completed. The determination of payments under the contract will be final in accordance with Section 1 05.1.

Failure to perform any of the obligations under the Contract by the Contractor may be decreed by the Contracting Agency to be adequate reason for withholding any payments until compliance is achieved.

Upon completion of all Work and after final inspection (Section 1-05.11), the amount due the Contractor under the Contract will be paid based upon the final estimate made by the Engineer and presentation of a Final Contract Voucher Certification to be signed by the Contractor. The Contractor's signature on such voucher shall be deemed a release of all claims of the Contractor unless a Certified Claim is filed in accordance with the requirements of Section 1-09.11 and is expressly excepted from the Contractor's certification on the Final Contract Voucher Certification. The date the Contracting Agency signs the Final Contract Voucher Certification constitutes the final acceptance date (Section 1-05.12).

If the Contractor fails, refuses, or is unable to sign and return the Final Contract Voucher Certification or any other documentation required for completion and final acceptance of the Contract, the Contracting Agency reserves the right to establish a Completion Date (for the purpose of meeting the requirements of RCW 60.28) and unilaterally accept the Contract. Unilateral final acceptance will occur only after the Contractor has been provided the opportunity, by written request from the Engineer, to voluntarily submit such documents. If voluntary compliance is not achieved, formal notification of the impending establishment of a Completion Date and unilateral final acceptance will be provided by email with delivery confirmation from the Contracting Agency to the Contractor, which will provide 30 calendar days for the Contractor to submit the necessary documents. The 30 calendar day period will begin on the date the email with delivery confirmation is received by the Contractor. The date the Contracting Agency unilaterally signs the Final Contract Voucher Certification shall constitute the Completion Date and the final acceptance date (Section 1-05.12). The reservation by the Contracting Agency to unilaterally accept the Contract will apply to Contracts that are Physically Completed in accordance with Section 1-08.5, or for Contracts that are terminated in accordance with Section 1-08.10. Unilateral final acceptance of the Contract by the Contracting Agency does

not in any way relieve the Contractor of their responsibility to comply with all Federal, State, tribal, or local laws, ordinances, and regulations that affect the Work under the Contract.

Payment to the Contractor of partial estimates, final estimates, and retained percentages shall be subject to controlling laws.

1-09.9(1) Retainage

Pursuant to RCW 60.28, a sum of 5 percent of the monies earned by the Contractor will be retained from progress estimates. Such retainage shall be used as a trust fund for the protection and payment (1) to the Contracting Agency with respect to taxes imposed pursuant to Title 82 RCW, and (2) the claims of any person arising under the Contract.

Monies retained under the provisions of RCW 60.28 shall, at the option of the Contractor, be:

1. Retained in a fund by the Contracting Agency; or
2. Deposited by the Contracting Agency in an escrow (interest-bearing) account in a bank, mutual saving bank, or savings and loan association (interest on monies so retained shall be paid to the Contractor). Deposits are to be in the name of the Contracting Agency and are not to be allowed to be withdrawn without the Contracting Agency's written authorization. The Contracting Agency will issue a check representing the sum of the monies reserved, payable to the bank or trust company. Such check shall be converted into bonds and securities chosen by the Contractor as the interest accrues.

At the time the Contract is executed the Contractor shall designate the option desired. The Contractor in choosing option (2) agrees to assume full responsibility to pay all costs that may accrue from escrow services, brokerage charges or both, and further agrees to assume all risks in connection with the investment of the retained percentages in securities. The Contracting Agency may also, at its option, accept a bond in lieu of retainage.

Release of the retainage will be made 60 days following the Completion Date (pursuant to RCW 39.12, and RCW 60.28) provided the following conditions are met:

1. On Contracts totaling more than $35,000, a release has been obtained from the Washington State Department of Revenue.
2. Affidavits of Wages Paid for the Contractor and all subcontractors are on file with the Contracting Agency (RCW 39.12.040).
3. A certificate of Payment of Contributions Penalties and Interest on Public Works Contract is received from the Washington State Employment Security Department.
4. Washington State Department of Labor and Industries (in accordance with Section 1-07.10) shows the Contractor is current with payments of industrial insurance and medical aid premiums.
5. All claims, as provided by law, filed against the retainage have been resolved. In the event claims are filed and provided the conditions of 1, 2, 3, and 4 are met, the Contractor will be paid such retained percentage less an amount sufficient to pay any such claims together with a sum determined by the Contracting Agency sufficient to

pay the cost of foreclosing on claims and to cover attorney's fees.

1-09.10 Vacant

1-09.11 Disputes and Claims

1-09.11(1) Vacant

1-09.11(2) Claims

If the Contractor claims that additional payment is due and the Contractor has pursued and exhausted all the means provided in Sections 1-04.5 and 1-04.5(1) to resolve a dispute, including the use of a Disputes Review Board if one was established, the Contractor may file a claim as provided in this section. If either the Contracting Agency or the Contractor does not accept the Dispute Review Board recommendation pursuant to Section 1-04.5(1), the Contractor shall submit to the Engineer a written notification of intent to file a Certified Claim, within 14 calendar days of the acceptance of Board recommendation. If a Dispute Review Board was not utilized, the Contractor shall submit to the Engineer written notification of intent to file a Certified Claim within 14 calendar days from the issuance of the Engineer's determination on merit of the protest pursuant to Section 1-04.5. The Contractor agrees to waive all claims for additional payment if the written notifications provided in Section 1-04.5 are not given, or if the Engineer is not afforded access by the Contractor to complete records of actual cost and additional time incurred as required by Section 1-04.5, or if a claim is not filed as provided in this section. The fact that the Contractor has provided a proper notification, provided a properly filed claim, or provided the Engineer access to records of actual cost, shall not in any way be construed as proving or substantiating the validity of the Certified Claim.

All Certified Claims filed by the Contractor shall be in writing and in sufficient detail to enable the Engineer to ascertain the basis and amount of the claim. All claims shall be submitted to the Engineer as provided in Section 1-05.15. As a minimum, the following information must accompany each claim submitted:

1. A detailed factual statement of the claim for additional compensation and time, if any, providing all necessary dates, locations, and items of Work affected by the claim.
2. The date on which facts arose that gave rise to the claim.
3. The name of each Contracting Agency individual, official, or employee involved in or knowledgeable about the claim.
4. The specific provisions of the Contract that support the claim and a statement of the reasons why such provisions support the claim.
5. If the claim relates to a decision of the Engineer that the Contract leaves to the Engineer's discretion or the Contract provides that the Engineer's decision is final, the Contractor shall set out in detail all facts supporting its position relating to the decision of the Engineer.
6. The identification of documents and the substance of oral communications that support the claim.
7. Copies of any identified documents, other than Contracting Agency documents and documents previously furnished to the Contracting Agency by the Contractor, that

support the claim (manuals that are standard to the industry, used by the Contractor, may be included by reference).

8. If an extension of time is sought:
   a. The specific days and dates for which it is sought,
   b. The specific reasons the Contractor believes a time extension should be granted,
   c. The specific provisions of Section 1-08.8 under which it is sought, and
   d. The Contractor's analysis of its progress schedule to demonstrate the reason for a time extension.
9. If additional compensation is sought, the exact amount sought and a breakdown of that amount into the following categories:
   a. Labor;
   b. Materials;
   c. Direct equipment. The actual cost for each piece of equipment for which a claim is made or in the absence of actual cost, the rates established by the AGC/WSDOT Equipment Rental Agreement that was in effect when the Work was performed. In no case shall the amounts claimed for each piece of equipment exceed the rates established by that Equipment Rental Agreement even if the actual cost for such equipment is higher. The Contracting Agency may audit the Contractor's cost records as provided in Section 1-09.12 to determine actual equipment cost. The following information shall be provided for each piece of equipment:
      (1) Detailed description (e.g., Motor Grader Diesel Powered Caterpillar 12 "G", Tractor Crawler ROPS & Dozer Included Diesel);
      (2) The hours of use or standby; and
      (3) The specific day and dates of use or standby;
   d. Job overhead;
   e. Overhead (general and administrative);
   f. Subcontractor's claims (in the same level of detail as specified herein is required for subcontractor's claims); and
   g. Other categories as specified by the Contractor or the Contracting Agency.
10. A notarized statement shall be submitted to the Engineer containing the following language:

    Under the penalty of law for perjury or falsification, the undersigned,

    _____, _____
    (name) (title)

    of _____
    (company)

    hereby certifies that the claim for extra compensation and time, if any, made herein for Work on this Contract is a true statement of the actual costs incurred

and time sought, and is fully documented and supported under the Contract between the parties.

Dated _____/s/_____

Subscribed and sworn before me this _____ day of _____

_____
Notary Public

My Commission Expires:_____

If the Certified Claim, after consideration by the Engineer, is found to have merit, the Engineer will make an equitable adjustment either in the amount of costs to be paid in accordance with Section 1-09.4 or in the time required for the Work, in accordance with Section 1-08.8 or both. If the Engineer finds the Certified Claim to be without merit, no adjustment will be made. If the Contractor does not accept the Engineer's determination as to its Certified Claim, then the Contractor shall pursue its remedies in accordance with Section 1-09.13.

It will be the responsibility of the Contractor to keep full and complete records of the costs and additional time incurred for an alleged claim. The Contractor shall permit the Engineer to have access to those records and all other records as may be required by the Engineer to determine the facts or contentions involved in the claim. The Contractor shall retain those records for a period of not less than three years after final acceptance.

The Contractor shall pursue administrative resolution of a claim with the Engineer or the designee of the Engineer.

When the Contractor fails to submit such Certified Claim information and details as described in this Section with the Final Contract Voucher Certification or prior to the Contracting Agency's unilateral final acceptance, all claims, including Certified Claims shall be waived as provided in Section 1-09.9.

Provided that the Contractor is in full compliance with all the provisions of this section and after the formal Certified Claim document has been submitted, the Contracting Agency will respond, in writing, to the Contractor as follows:

1. Within 45 calendar days from the date the claim is received by the Contracting Agency if the claim amount is less than $200,000;
2. Within 90 calendar days from the date the claim is received by the Contracting Agency if the claim amount is equal to or greater than $200,000; or
3. If the above time restraints are insufficient due to the complexity of the claim under consideration, the Contractor will be notified within 14 calendar days from the date the claim is received by the Contracting Agency as to the amount of time that will be necessary for the Contracting Agency to prepare its response.

Full compliance by the Contractor with the provisions of this section is a contractual condition precedent to the Contractor's right to seek judicial relief.

1-09.11(3) Time Limitation and Jurisdiction

For the convenience of the parties to the Contract it is mutually agreed by the parties that any claims or causes of action which the Contractor has against the Contracting Agency arising from the Contract shall be brought within 180 calendar days from the date of final acceptance (Section 1-05.12) of the Contract by the Contracting Agency; and it is further agreed that any such claims or causes of action shall be brought only in the Superior Court of the county where the Contracting Agency headquarters is located, provided that where an action is asserted against a county, RCW 36.01.050 shall control venue and jurisdiction. The parties understand and agree that the Contractor's failure to bring suit within the time period provided, shall be a complete bar to any such claims or causes of action. It is further mutually agreed by the parties that when any claims or causes of action which the Contractor asserts against the Contracting Agency arising from the Contract are filed with the Contracting Agency or initiated in court, the Contractor shall permit the Contracting Agency to have timely access to any records deemed necessary by the Contracting Agency to assist in evaluating the claims or action.

1-09.12 Audits

1-09.12(1) General

The Contractor's wage, payroll, and cost records on this Contract shall be open to inspection or audit by representatives of the Contracting Agency during the life of the Contract and for a period of not less than 3 years after the date of final acceptance of the Contract. The Contractor shall retain these records for that period. The Contractor shall also guarantee that the wage, payroll, and cost records of all subcontractors shall be retained and open to similar inspection or audit for the same period of time. The audit may be performed by employees of the Contracting Agency or by an auditor under contract with the Contracting Agency. The Contractor and subcontractors shall provide adequate facilities, acceptable to the Engineer, for the audit during normal business hours. The Contractor and subcontractors shall make a good faith effort to cooperate with the auditors. If an audit is to be commenced more than 60 calendar days after the final acceptance date of the Contract, the Contractor will be given 20 calendar days' notice of the time when the audit is to begin. If any litigation, claim, or audit arising out of, in connection with, or related to this Contract is initiated, the wage, payroll, and cost records shall be retained until such litigation, claim, or audit involving the records is completed.

1-09.12(2) Audits - Claims

All Certified Claims filed against the Contracting Agency shall be subject to audit at any time following the filing of the claim. Failure of the Contractor or subcontractors to maintain and retain sufficient records to allow the auditors to verify all or a portion of the claim or to permit the auditor access to the books and records of the Contractor or subcontractors shall constitute a waiver of a claim and shall bar recovery thereunder.

1-09.12(3) Required Documents for Audits

As a minimum, the auditors shall have available to them the following documents:

1. Daily time sheets and supervisor's daily reports.

2. Collective Bargaining Agreements.
3. Insurance, welfare, and benefits records.
4. Payroll registers.
5. Earnings records.
6. Payroll tax forms.
7. Material invoices and requisitions.
8. Material cost distribution worksheet.
9. Equipment records.
10. Invoices for vendors, rental agencies and subcontractors.
11. Contracts between the Contractor and each of its first-tier subcontractors. All lower-tier subcontractor contracts, and supplier contracts.
12. Subcontractors' payment certificates.
13. Canceled checks (payroll and vendors).
14. Job cost reports, including monthly totals.
15. Job payroll ledger.
16. General ledger.
17. Cash disbursements journal.
18. Financial statements for all years reflecting the operations on this Contract. In addition, the Contracting Agency may require, if it deems appropriate, additional financial statements for 3 years preceding execution of the Contract and 3 years following final acceptance of the Contract.
19. Depreciation records on all company equipment whether these records are maintained by the company involved, its accountant, or others.
20. If a source other than depreciation records is used to develop costs for the Contractor's internal purposes in establishing the actual cost of owning and operating equipment, all such other source documents.
21. All documents, including those to support the amount of damages for each claim.
22. Worksheets or software used to prepare claims for establishing the following:
    a. Cost components for items
    b. Cost of labor
    c. Cost of benefits and insurance
    d. Cost of materials
    e. Cost of equipment
    f. Subcontractor's costs
    g. Analysis of time periods
    h. Tabulation of individuals involved, and hours worked
    i. Wage rates for the individuals
23. Worksheets, software, and all other documents used by the Contractor to prepare

its Bid.

An audit may be performed by employees of the Contracting Agency or a representative of the Contracting Agency. The Contractor and its subcontractors shall provide adequate facilities acceptable to the Contracting Agency for the audit during normal business hours. The Contractor and all subcontractors shall cooperate with the Contracting Agency's auditors.

1-09.13 Claims Resolution

1-09.13(1) Conditions Precedent to Binding Arbitration or Litigation

1-09.13(1)A General

Prior to seeking claims resolution through arbitration or litigation, the Contractor shall proceed in accordance with Sections 1-04.5 and 1-09.11. The provisions of Sections 1-04.5 and 1-09.11 must be complied with in full as a condition precedent to the Contractor's right to seek claim resolution through binding arbitration or litigation.

Any claims or causes of action which the Contractor has against the Contracting Agency arising from the Contract shall be resolved, as prescribed herein, through binding arbitration or litigation.

The Contractor and the Contracting Agency mutually agree that those claims or causes of action which total $1,000,000 or less, which are not resolved by mediation, shall be resolved through mandatory and binding arbitration as described herein, subject to the limitations described in Section 1-09.13(3)C.

The Contractor and the Contracting Agency mutually agree that those claims or causes of action in excess of $1,000,000, which are not resolved by mediation, shall be resolved through litigation unless the parties mutually agree in writing to resolve the claim through binding arbitration.

1-09.13(1)B Time Limitation

For the convenience of the parties to the Contract, it is mutually agreed by the parties that any arbitration or litigation shall be initiated within 180 calendar days from the "acceptance date" described in Section 1-05.12, Final Acceptance. Arbitration shall be deemed to be initiated on the date the Contractor has successfully completed the requirements of Section 1-09.13(3)B, Procedure to Initiate Arbitration. Litigation shall be deemed to be initiated on the date the Contractor files a cause of action with the Thurston County Superior Court, or such other Superior Court as mutually agreed to in writing by the parties. The parties understand and agree that the Contractor's failure to initiate arbitration or initiate litigation within the time period provided shall be a complete bar to any such claims or causes of action.

1-09.13(2) Mediation

After the Contracting Agency has been given the time and opportunity to respond to the Contractor as provided in Section 1-09.11(2), mediation may be used upon mutual agreement of the Contractor and the Contracting Agency. When parties mutually agree to use mediation, the following conditions apply:

1. The cost of the mediation shall be shared equally by both parties with each party bearing its own preparation costs.

2. The mediation shall be conducted within the State of Washington at a time and place mutually agreeable.
3. The Contractor agrees that the participation in a mediation does not in any way waive the requirement that binding arbitration or litigation proceedings must commence within 180 calendar days of final acceptance of the Contract, the same as other claims or causes of action as provided in Section 1-09.11(3).

1-09.13(3) Arbitration

1-09.13(3)A Arbitration General

Arbitration shall be administered through the American Arbitration Association (AAA) using the following arbitration methods:

1. For Certified Claims with an amount less than or equal to $250,000 the current version of the Construction Industry Arbitration Rules and Mediation Procedures *Fast Track Procedures* shall be used.
2. For Certified Claims with an amount greater than $250,000 and less than or equal to a $1,000,000, the current version of the Construction Industry Arbitration Rules and Mediation Procedures *Regular Track Procedures* shall be used subject to the limitation in Section 1-09.13(3)C.

Certain aspects of the arbitration may be held by video conference if agreed by the parties and the arbitrator. If aspects of the arbitration require the parties to be at the same physical location, the locale shall be as agreed by the parties and the arbitrator, but in any case, within the state of Washington. If the parties and the arbitrator are unable to agree, the locale shall be in which the Contracting Agency's headquarters is located.

The Contracting Agency and the Contractor mutually agree to be bound by the decision of the arbitrator, and judgment upon the award rendered by the arbitrator may be entered in the Superior Court of the county in which the Contracting Agency's headquarters is located, provided that where claims subject to arbitration are asserted against a county, RCW 36.01.050 shall control venue and jurisdiction of the Superior Court. The decision of the arbitrator and the specific basis for the decision shall be in writing. The arbitrator shall use the Contract as a basis for decisions.

1-09.13(3)B Procedure to Initiate Arbitration

The Contractor shall file a demand with the AAA in accordance with item (a) "Filing a Demand," of Section R-4 "Filing Requirements Under Arbitration Agreement in a Contract", of The Construction Industry Arbitration Rules and Mediation Procedures of the American Arbitration Association, amended effective July 1, 2015. The fee schedule used shall be the fee schedule effective on the date of filing. The Contractor shall notify the Engineer, in writing, that a demand has been filed with the AAA.

1-09.13(3)C Limitations on Arbitration Related to Physical Completion

Unresolved disputes which do not involve delays or impacts to unchanged Work may be brought to binding arbitration prior to Physical Completion of the project, provided the Contractor certifies in writing that claims for delays or impacts to the Work will not result from the dispute.

Unless the Contracting Agency and the Contractor agree otherwise, all other unresolved claims (disputes which have been pursued to the claim status) which arise from a Contract must be brought in a single arbitration hearing and only after Physical Completion of the Contract. The total of those unresolved claims cannot be greater than $1,000,000 to be eligible for arbitration.

1-09.13(4) Venue for Litigation

Litigation shall be brought in the Superior Court of Thurston County or such other Superior Court as mutually agreed to in writing by the parties. It is mutually agreed by the parties that when litigation occurs, the Contractor shall permit the Contracting Agency to have timely access to all records deemed necessary by the Contracting Agency to assist in evaluating the claims or action.

1-10 Temporary Traffic Control

1-10.1 General

Temporary traffic control refers to the control of all types of traffic, including vehicles, bicyclists, and pedestrians (including pedestrians with disabilities). The Contractor, utilizing contractor labor and contractor-provided equipment and materials (except when such labor, equipment, or materials are to be provided by the Contracting Agency as specifically identified herein), shall plan, manage, supervise, and perform all temporary traffic control activities needed to support the Work of the Contract.

1-10.1(1) Materials

Materials shall meet the requirements of the following Sections:

Traffic Control Materials	9-35

1-10.1(2) Description

Unless otherwise permitted by the Contract or approved by the Engineer, the Contractor shall keep all existing pedestrian routes and access points (including sidewalks, paths, crosswalks, and detectable warning surfaces) open and clear at all times.

The Contractor shall keep lanes open to traffic at all times.

The Contractor shall provide signs and other traffic control devices. The Contractor shall erect and maintain all construction signs, warning signs, detour signs, and other traffic control devices necessary to warn and protect the public at all times from injury or damage as a result of the Contractor's operations, which may occur on or adjacent to Highways, roads, streets, sidewalks, or paths. No Work shall be done on or adjacent to any Traveled Way until all necessary signs and traffic control devices are in place.

The traffic control resources and activities described shall be used for the safety of the public, of the Contractor's employees, and of the Contracting Agency's personnel and to facilitate the movement of the traveling public. Traffic control resources and activities may be used for the separation or merging of public and construction traffic when such use is in accordance with a specific traffic control plan.

Upon failure of the Contractor to immediately provide flaggers; erect, maintain, and remove signs; or provide, erect, maintain, and remove other traffic control devices when ordered to do so by the Engineer, the Contracting Agency may, without further notice to the Contractor or the Surety, perform any of the above and deduct all of the costs from

the Contractor's payments.

The Contractor shall be responsible for providing adequate labor, sufficient signs, and other traffic control devices, and for performing traffic control procedures needed for the protection of the Work and the public at all times regardless of whether or not the labor, devices or procedures have been ordered by the Engineer, furnished by the Contracting Agency, or paid for by the Contracting Agency.

Wherever possible when performing Contract Work, the Contractor's equipment shall follow normal and legal traffic movements. The Contractor's ingress and egress of the Work area shall be accomplished with as little disruption to traffic as possible. Traffic control devices shall be removed by picking up the devices in a reverse sequence to that used for installation. This may require moving backwards through the work zone. When located behind barrier or at other locations shown on the traffic control plans, equipment may operate in a direction opposite to adjacent traffic.

1-10.2 Traffic Control Management

1-10.2(1) General

It is the Contractor's responsibility to plan, conduct, and safely perform the Work. The Contractor shall manage temporary traffic control with his or her own staff. Traffic control management responsibilities shall be formally assigned to one or more company supervisors who are actively involved in the planning and management of field Contract activities. The Contractor shall provide the Engineer with a copy of the formal assignment. The duties of traffic control management may not be subcontracted.

1-10.2(2) Traffic Control Plans

When the Contractor's chosen method of performing the Work in the Contract requires some form of temporary traffic control, for vehicles, bicyclists, or pedestrians, the Contractor shall either: (1) submit a Type 1 Working Drawing designating and adopting, in writing, the traffic control plans from the Contract documents that support that method; or (2) submit a Type 2 Working Drawing consisting of the Contractor's plan that modifies, supplements or replaces a plan from the Contract documents. Any Contractor-proposed modification, supplement or replacement shall show the necessary construction signs, flaggers, and other traffic control devices required to support the Work. The Contractor shall be solely responsible for submitting any proposed traffic control plan or modification, obtaining the Engineer's acceptance, and providing copies of the accepted traffic control plans to the Traffic Control Supervisor.

Development of a Traffic Control Plan shall be the responsibility of the Contractor. The Contractor shall submit their Traffic Control Plan for the Engineer's review 30 working days prior to any work on SR 307 Bond Road. No work shall be undertaken until the Contractor has written approval of the Traffic Control Plan.

1-10.2(3) Conformance to Established Standards

Traffic control plans, signs, and all traffic control devices and procedures furnished or provided shall conform to the standards established in the latest WSDOT adopted edition (in accordance with WAC 468-95) of the MUTCD, published by the U.S. Department of Transportation. Flagging shall also be in accordance with WAC 296-155-305 and pedestrian traffic control shall also be in accordance with the Public Rights-of-

Way Accessibility Guidelines (PROWAG) www.access-board.gov/prowag. Judgment of the quality of devices furnished will be based upon Quality Guidelines for Temporary Traffic Control Devices, published by the American Traffic Safety Services Association. Copies of the MUTCD and Quality Guidelines for Temporary Control Devices may be purchased from the American Traffic Safety Services Association, 15 Riverside Parkway, Suite 100, Fredericksburg, VA 22406-1022.

KITSAP COUNTY DEPARTMENT OF PUBLIC WORKS
COUNTY ROAD PROJECT NO. 1632

NORTH KITSAP SERVICE CENTER

VOLUME 2 OF 3

SPECIAL PROVISIONS
DIVISION 2 THROUGH 46

KITSAP COUNTY DEPARTMENT OF PUBLIC WORKS
614 DIVISION STREET, MS-26
PORT ORCHARD, WASHINGTON 98366-4699
360.337.5777

BACK OF COVER

KITSAP COUNTY PUBLIC WORKS
NORTH KITSAP SERVICE CENTER

VOLUME 2 OF 3

SPECIAL PROVISIONS
DIVISION 2 THROUGH 46

DIVISION 02 **EXISTING CONDITIONS** (NOT USED)

DIVISION 03 **CONCRETE**
- 03 05 16 Underslab Vapor Barrier
- 03 30 00 Cast-in-Place Concrete
- 03 35 43 Polished Concrete Finishing
- 03 47 13 Tilt-Up Concrete

DIVISION 04 **MASONRY** (NOT USED)

DIVISION 05 **METALS**
- 05 12 00 Structural Steel Framing
- 05 31 00 Steel Decking
- 05 40 00 Cold-Formed Metal Framing
- 05 50 00 Metal Fabrications
- 05 51 00 Metal Stairs
- 05 52 13 Pipe and Tube Railings
- 05 75 10 Perforated Metal Panels

DIVISION 06 **WOOD, PLASTIC, AND COMPOSITES**
- 06 10 00 Rough Carpentry

DIVISION 07 **THERMAL AND MOISTURE PROTECTION**
- 07 11 13 Bituminous Dampproofing
- 07 14 00 Fluid-Applied Waterproofing
- 07 19 00 Water Repellents
- 07 21 00 Thermal Insulation
- 07 25 00 Weather Barriers
- 07 41 13 Metal Roof Panels
- 07 42 13 Metal Wall Panels
- 07 42 43 Composite Wall Panels
- 07 53 23 EPDM Thermoset Single-Ply Roofing
- 07 62 00 Sheet Metal Flashing and Trim
- 07 72 00 Roof Accessories
- 07 81 23 Intumescent Fire Protection
- 07 84 00 Firestopping
- 07 92 00 Joint Sealants

DIVISION 08 **OPENINGS**
- 08 11 13 Hollow Metal Doors and Frames
- 08 14 16 Flush Wood Doors
- 08 31 00 Access Doors and Panels
- 08 33 23 Overhead Coiling Doors

08 36 13	Sectional Doors
08 42 29	Automatic Entrances
08 43 13	Aluminum-Framed Storefronts
08 45 00	Translucent Wall and Roof Assemblies
08 71 00	Door Hardware
08 80 00	Glazing
08 91 00	Louvers
DIVISION 09	**FINISHES**
09 21 16	Gypsum Board Assemblies
09 51 00	Acoustical Ceilings
09 65 00	Resilient Flooring
09 67 00	Fluid-Applied Flooring
09 84 36	Sound-Absorbing Ceiling Units
09 90 00	Painting and Coating
09 96 00	High-Performance Coatings
DIVISION 10	**SPECIALTIES**
10 14 23	Panel Signage
10 26 00	Wall and Door Protection
10 28 00	Toilet, Bath, Laundry and Cleaning Accessories
10 44 00	Fire Protection Specialties
10 51 13	Metal Lockers
10 56 13	Metal Storage Shelving
10 56 29	Vertical Tire Storage Carousel
10 56 29.26	Cantilever Storage Racks
DIVISION 11	**EQUIPMENT**
11 11 19	Lube Room Equipment
11 11 23	Tire Changer and Balancer Equipment
11 13 19	Stationary Loading Dock Equipment
11 30 13	Appliances
11 50 00	Shop Equipment
11 53 00	Equipment
11 53 13	Laboratory Fume Hoods
DIVISION 12	**FURNISHINGS**
12 24 00	Window Shades
12 32 00	Manufactured Wood Casework
12 36 00	Countertops
12 48 13	Entrance Floor Mats and Frames
DIVISION 13	**SPECIAL CONSTRUCTION** (NOT USED)
DIVISION 14	**CONVEYING EQUIPMENT**
14 45 13	Vehicle Lift Equipment
DIVISION 21	**FIRE SUPPRESSION**
21 05 00	Common Work Results for Fire Suppression Systems
21 05 53	Identification for Fire Suppression Piping and Equipment
21 13 13	Wet-Pipe Sprinkler Systems
21 13 16	Dry-Pipe Sprinkler Systems

DIVISION 22	**PLUMBING**
22 00 00	General Plumbing Requirements
22 05 00	Common Work Results for Plumbing
22 05 17	Sleeves and Sleeve Seals for Plumbing Piping
22 05 18	Escutcheons for Plumbing Piping
22 05 19	Meters and Gages for Plumbing Piping
22 05 23	General Duty Valves for Plumbing Piping
22 05 29	Hangers and Supports for Plumbing Piping and Equipment
22 05 48	Vibration and Seismic Controls for Plumbing Piping and Equipment
22 05 53	Identification for Plumbing Piping and Equipment
22 07 19	Plumbing Piping Insulation
22 11 16	Domestic Water Piping
22 11 19	Domestic Water Piping Specialties
22 11 23.21	Inline, Domestic-Water Pumps
22 13 16	Sanitary Waste and Vent Piping
22 13 19	Sanitary Waste Piping Specialties
22 13 23	Sanitary Waste Interceptors
22 14 13	Facility Storm Drainage Piping
22 14 23	Storm Drainage Piping Specialties
22 15 13	General-Service Compressed-Air Piping
22 15 19	General-Service Packaged Air Compressors and Receivers
22 16 19	Disinfection of Potable Water System
22 33 00	Electric Domestic Water Heaters
22 40 00	Plumbing Fixtures
22 45 00	Emergency Plumbing Fixtures
22 70 00	Vehicle Wash System
DIVISION 23	**HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)**
23 00 00	General Mechanical Requirements
23 05 13	Common Motor Requirements for HVAC Equipment
23 05 17	Sleeves and Sleeve Seals for HVAC Piping
23 05 18	Escutcheons for HVAC Piping
23 05 19	Meters and Gauges for HVAC Piping
23 05 23.12	Ball Valves for HVAV Piping
23 05 23.14	Check Valves for HVAC Piping
23 05 29	Hangers and Supports for HVAC Piping and Equipment
23 05 48	Vibration and Seismic Controls for HVAC
23 05 49	Variable Frequency Drives
23 05 53	Identification for HVAC Piping and Equipment
23 05 93	Testing, Adjusting, and Balancing for HVAC
23 07 13	Duct Insulation
23 07 16	HVAC Equipment Insulation
23 07 19	HVAC Piping Insulation
23 08 00	Commissioning of HVAC
23 09 00	Instrumentation and Control for HVAC
23 13 23.16	Vertical Storage Tank
23 21 13	Hydronic Piping
23 21 13.13	Underground Hydronic Piping
23 21 16	Hydronic Piping Specialties
23 21 23	Hydronic Pumps
23 25 13	Water Treatment for Closed-Loop Hydronic Systems
23 31 13	Metal Ducts

23 33 00	Air Duct Accessories
23 34 23	HVAC Fans
23 35 16	Hose Reel Equipment
23 37 13	Diffusers, Registers, and Grilles
23 37 23	HVAC Gravity Ventilators
23 64 33	Air Heated Modular Water Heater
23 74 33	Dedicated Outdoor-Air Units
23 81 26	Split-System Air-Conditioners
23 81 46	Water-Source Unitary Heat Pumps
23 82 16	Air Coils
23 82 39.13	Cabinet Unit Heaters
23 82 39.19	Wall and Ceiling Unit Heaters
23 83 16	Radiant-Heating Hydronic Piping
23 83 23	Radiant-Heating Electric Panels

DIVISION 25 **INTEGRATED AUTOMATION** (NOT USED)

DIVISION 26 **ELECTRICAL**

26 00 00	General Electrical Requirements
26 05 19	Low-Voltage Electrical Power Conductors and Cables
26 05 26	Grounding Bonding for Electrical Systems
26 05 29	Hangers and Supports for Electrical Systems
26 05 33	Raceways and Boxes for Electrical Systems
26 05 43	Underground Ducts and Raceways for Electrical Systems
26 05 44	Sleeves and Sleeve Seals for Electrical Raceways and Cabling
26 05 48	Vibration and Seismic Controls for Electrical Systems
26 05 53	Identification for Electrical Systems
26 05 73	Short Circuit, Coordination and Arc Flash Studies
26 09 13	Electrical Power Monitoring and Control
26 09 43	Network Lighting Controls
26 22 00	Low-Voltage Transformers
26 24 13	Switchboards
26 24 16	Panelboards
26 25 00	Enclosed Bus Assemblies
26 27 13	Electricity Metering
26 27 26	Wiring Devices
26 28 13	Fuses
26 28 16	Enclosed Switches and Circuit Breakers
26 31 00	Photovoltaic Collectors
26 32 13	Engine Generators
26 36 00	Transfer Switches
26 43 13	Surge Protection for Low-Voltage Electrical Power Circuits
26 51 19	LED Interior Lighting
26 56 19	LED Exterior Lighting

DIVISION 27 **COMMUNICATIONS**

27 05 00	Requirements for Communications Installations
27 05 26	Grounding Bonding for Communications Systems
27 05 29	Hangers and Supports for Communications Systems
27 05 33	Conduits and Boxes for Communications Systems
27 05 36	Cable Trays for Communications Systems
27 05 43	Underground Ducts for Communications Systems

27 05 53	Identification for Communications Systems
27 11 16	Cabinets, Racks, Enclosures for Communications Systems
27 11 19	Termination Blocks and Patch Panels for Communications
27 11 26	Power Distribution Unit (PDU)
27 13 13	Communications Copper Backbone Cabling
27 13 23	Communications Optical Fiber Backbone Cabling
27 15 13	Copper Horizontal Cabling
27 15 15	Powered Fiber Cable System Data Communications Horizontal Cabling
27 15 43	Communications Faceplates and Connectors
27 16 19	Communication Patch Cords, Station Cords, and Cross Connect Wire
DIVISION 28	**ELECTRONIC SAFETY AND SECURITY**
28 05 00	Common Work Results for Electronic Safety and Security
28 16 00	Intrusion Detection Systems
28 23 00	Video Surveillance System
28 46 21	Addressable Fire-Alarm Systems
DIVISION 31	**EARTHWORK**
31 10 00	Site Clearing
31 20 00	Earthwork
31 25 14	Soil Erosion and Sediment Control
DIVISION 32	**EXTERIOR IMPROVEMENTS**
32 11 23	Aggregate Base Courses
32 12 16	Hot Mix Asphalt (HMA) Paving
32 13 13	Rigid Concrete Pavement
32 16 23	Sidewalks
32 17 13	Parking Bumpers
32 17 23	Pavement Markings
32 17 26	Detectable Warning Surfacing
32 31 13	Chain Link Fences and Gates
32 31 13.01	Motorized Cantilever Slide Gates
32 31 37	Automatic Barrier Gates
32 32 60	Material Storage, Brine Maker, Salt Storage Walls and Roofs
32 32 61	Structural Earth Walls
32 32 62	Soldier Pile Walls
32 39 40	Sander Insert Rack
32 84 00	Irrigation
32 90 00	Planting
DIVISION 33	**UTILITIES**
33 08 55	Commissioning of Fuel Facility Systems
33 14 16	Site Water Utility Distribution Piping
33 16 00	Storage Tanks
33 31 23.01	OSS Effluent Transport Piping
33 34 13	Septic Tanks and Pump Chambers
33 34 51	OSS Drainfields
33 42 11	Stormwater Gravity Piping
33 46 00	Stormwater Management
33 46 02	Stormwater Hydrodynamic Separator
33 46 03	Stormwater Oil Separator
33 46 04	Stormwater Biofiltration Vault
33 52 10	Fuel-Oil System

DIVISION 34 **TRANSPORTATION** (NOT USED)

DIVISION 35 **WATERWAY AND MARINE CONSTRUCTION** (NOT USED)

DIVISION 40 **PROCESS INTEGRATION** (NOT USED)

DIVISION 41 **MATERIAL PROCESSING AND HANDLING EQUIPMENT**
41 23 13.13 Bridge Crane Equipment

DIVISION 42 **PROCESS HEATING, COOLING, AND DRYING EQUIPMENT** (NOT USED)

DIVISION 43 **PROCESS GAS AND LIQUID HANDLING, PURIFICATION AND STORAGE EQUIPMENT** (NOT USED)

DIVISION 44 **POLLUTION CONTROL EQUIPMENT**
44 13 20 Mobile Fume Extractor Equipment

DIVISION 45 **INDUSTRY-SPECIFIC MANUFACTURING EQUIPMENT** (NOT USED)

DIVISION 46 **WATER AND WASTEWATER EQUIPMENT** (NOT USED)

SECTION 03 05 16
UNDERSLAB VAPOR BARRIER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sheet vapor barrier under concrete slabs on grade at buildings as shown on Architectural Drawings.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.03 REFERENCE STANDARDS

A. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs 2018a.

B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs 2017 (Reapproved 2023).

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Submit manufacturers' data on manufactured products.

C. Test Data: Submit report of tests showing compliance with specified requirements.

D. Samples: Submit samples of underslab vapor barrier to be used.

E. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

PART 2 PRODUCTS

2.01 MATERIALS

A. Underslab Vapor Barrier:
   1. Water Vapor Permeance: Not more than 0.010 perms (0.6 ng/(s m2 Pa)), maximum.
   2. Complying with ASTM E1745 Class A.
   3. Thickness: 15 mils (0.4 mm).
   4. Basis of Design:
      a. Stego Industries LLC; Stego Wrap Vapor Barrier (15-mil): www.stegoindustries.com/#sle.
      b. Substitutions: See Section 1-06.7.

B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

3.02 INSTALLATION

A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.

B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.

C. Lap joints minimum 6 inches (150 mm).

D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.

E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.

F. Repair damaged vapor retarder before covering with other materials.

END OF SECTION 03 05 16

This page intentionally left blank

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork.

B. Concrete building frame members.

C. Floors and slabs on grade.

D. Concrete shear walls and foundation walls.

E. Concrete foundations and anchor bolts for pre-engineered building.

F. Concrete foundations for storage tank(s).

G. Concrete reinforcement.

H. Joint devices associated with concrete work.

I. Miscellaneous concrete elements, including equipment pads, equipment pits, and light pole bases.

J. Concrete curing.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 – Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

1.03 REFERENCE STANDARDS

A. ACI 117 – Specification for Tolerances for Concrete Construction and Materials 2015 .

B. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete 2009 .

C. ACI 301 – Specifications for Concrete Construction 2020.

D. ACI 302.1R – Guide to Concrete Floor and Slab Construction 2015.

E. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete 2009.

F. ACI 305R – Guide to Hot Weather Concreting 2020.

G. ACI 306R – Guide to Cold Weather Concreting 2016.

H. ACI 308R – Guide to External Curing of Concrete 2016.

I. ACI 318 – Building Code Requirements for Structural Concrete 2021.

J. ACI 347R – Guide to Formwork for Concrete 2021.

K. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2022.

L. ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete .

M. ASTM C33 – Standard Specification for Concrete Aggregates 2018.

N. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens 2021.

O. ASTM C94 – Standard Specification for Ready-Mixed Concrete 2022.

P. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete 2020.

Q. ASTM C150 – Standard Specification for Portland Cement 2022.

R. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method 2016.

S. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete 2010a (Reapproved 2016).

T. ASTM C476 – Standard Specification for Grout for Masonry 2020.

U. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete 2019, with Editorial Revision (2022).

V. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete 2022.

W. ASTM C685 – Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing 2017.

X. ASTM C827 – Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures 2016.

Y. ASTM C881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete 2020a.

Z. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2020.

AA. ASTM C1202 – Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration 2019.

BB. ASTM C1240 – Standard Specification for Silica Fume Used in Cementitious Mixtures 2020.

CC. ASTM C1260 – Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method) 2021.

DD. ASTM C1582 – Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete 2017.

EE. ASTM C1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete 2018.

FF. ASTM C1708 – Standard Test Methods for Self-leveling Mortars Containing Hydraulic Cements 2019.

GG. ASTM D994 – Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type) 2022.

HH. ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) 2018.

II. ASTM D1752 – Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction 2018.

JJ. ASTM D2103 – Standard Specification for Polyethylene Film and Sheeting 2015.

KK. ASTM D8139 – Standard Specification for Semi-Rigid, Closed-Cell Polypropylene Foam, Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction 2017.

LL. ASTM E96 – Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022.

MM. ASTM E154 – Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover 2019.

NN. ASTM E1155 – Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers 2020.

OO. ASTM E1643 – Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs 2018a.

PP. ASTM E1745 – Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs 2017.

QQ. ASTM E1993 – Standard Specification for Bituminous Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs 2020.

RR. COE CRD-C 48 – Handbook for Concrete and Cement Standard Test Method for Water Permeability of Concrete 1992.

SS. COE CRD-C 513 – Handbook for Concrete and Cement Corps of Engineers Specifications for Rubber Waterstops 1974.

TT. COE CRD-C 572 – Handbook for Concrete and Cement Corps of Engineers Specifications for Polyvinylchloride Waterstop 1974.

UU. ICRI 310.2R – Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair 2013.

1.04 SUBMITTALS

A. See Section 1-06 for submittal requirements.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
   1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.
   2. For chemical-resistant waterstops, provide data on ASTM D471 test results.
   3. For membrane-forming, moisture emission-reducing, curing and sealing compound, provide manufacturer's installation instructions.

C. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 – Concrete Mixtures.
   2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 – Concrete Quality, Mixing and Placing.
   3. Indicate proposed mix design complies with admixture manufacturer's written recommendations.
   4. Indicate proposed mix design complies with expansive component manufacturer's written recommendations.

D. Samples: Submit two, 12 inch long samples of waterstops and construction joint devices.

E. Test Reports: Submit report for each test or series of tests specified.

F. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.

G. Sustainable Design Submittal: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of Portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.

H. Sustainable Design Submittal: Submit environmental assessment report for concrete mix. Compare concrete mix submitted with a conventional or reference concrete mixture that meets the specified performance requirements. Include:
   1. Energy consumption.
   2. Emissions.
   3. Potential toxicity.
   4. Potential risk.
   5. Raw material consumption.
   6. Land use.
   7. Third-party validation of comparison methodology.

I. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.
   1. Maintain one copy of each document on site.

B. Follow recommendations of ACI 305R when concreting during hot weather.

C. Follow recommendations of ACI 306R when concreting during cold weather.

D. For slabs required to include moisture vapor reducing admixture (MVRA), do not proceed with placement unless manufacturer's representative is present for every day of placement.

E. For slabs indicated to receive membrane-forming, moisture emission-reducing, curing and sealing compound, do not proceed with application unless manufacturer's representative is present for every day of placement.

1.06 MOCK-UP

A. Construct and erect mock-up panel for architectural concrete surfaces indicated to receive special treatment or finish as result of formwork.
   1. Panel Size: Sufficient to illustrate full range of treatment.
   2. Panel Size: 6 by 6 feet .
   3. Panel Size: As indicated on architectural drawings.
   4. Number of Panels: Two.
   5. Locate as indicated on drawings.

B. If requested by Architect, cast concrete against mock-up panel. Obtain acceptance of resulting surface finish prior to erecting formwork.

C. Accepted mock-up panel is considered basis of quality for the finished work. Keep mock-up exposed to view for duration of concrete work.

D. Mock-up may remain as part of the Work.

PART 2 PRODUCTS

2.01 FORMWORK

A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.

B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
   1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
   2. Form Facing for Exposed Finish Concrete: Steel.
   3. Earth Cuts: Do not use earth cuts as forms for vertical surfaces. Natural rock formations that maintain a stable vertical edge may be used as side forms.
   4. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
   5. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.02 REINFORCEMENT MATERIALS

A. Reinforcing Steel: ASTM A615, Grade 60 (60,000 psi).
   1. Type: Deformed billet-steel bars.
   2. Finish: Unfinished, unless otherwise indicated.
   3. Finish: Galvanized in accordance with ASTM A767, Class I, unless otherwise indicated.

B. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I – Normal Portland type.
   1. Acquire cement for entire project from same source.
   2. Products:
      a. CTS Cement Manufacturing Corporation; Type K Cement: www.ctscement.com/#sle.
      b. Euclid Chemical Company; EUCON MSA: www.euclidchemical.com/#sle.

c. Substitutions: Substitutions: See Section 1-06.7.

B. Fine and Coarse Aggregates: ASTM C33.
   1. Acquire aggregates for entire project from same source.

C. Fly Ash: ASTM C618, Class C or F.

D. Calcined Pozzolan: ASTM C618, Class N.

E. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.

F. Water: ASTM C1602; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

A. Chemical Admixture:
   1. Manufacturers: Per structural drawings
      a. Substitutions: See Section 1-06.7.

B. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

C. Air Entrainment Admixture: ASTM C260.
   1. Manufacturers: Per structural drawings
      a. Substitutions: See Section 1-06.7.

D. High Range Water Reducing and Retarding Admixture: ASTM C494 Type G.
   1. Products: Per structural drawings
      a. Substitutions: See Section 1-06.7.

E. High Range Water Reducing Admixture: ASTM C494 Type F.
   1. Products:
      a. Euclid Chemical Company; PLASTOL 6420: www.euclidchemical.com/#sle.
      b. Substitutions: See Section 1-06.7.

F. Water Reducing and Accelerating Admixture: ASTM C494 Type E.
   1. Products:
      a. Euclid Chemical Company; ACCELGUARD 80: www.euclidchemical.com/#sle.
      b. Substitutions: See Section 1-06.7.

G. Water Reducing and Retarding Admixture: ASTM C494 Type D.
   1. Provide pigmented type, with ASTM C979/C979M inorganic pigments.
   2. Products: Per structural drawings
      a. Substitutions: See Section 1-06.7.

H. Accelerating Admixture: ASTM C494 Type C.
   1. Products:
      a. W. R. Meadows, Inc; Hydraset: www.wrmeadows.com/#sle.
      b. Substitutions: See Section 1-06.7.

I. Retarding Admixture: ASTM C494 Type B.
   1. Products: Per structural drawings
      a. Substitutions: See Section 1-06.7.

J. Water Reducing Admixture: ASTM C494 Type A.
   1. Products:
      a. Euclid Chemical Company; EUCON NW: www.euclidchemical.com/#sle.
      b. Substitutions: See Section 1-06.7.

K. Shrinkage Reducing Admixture:
   1. ASTM C494, Type S.
   2. Products:
      a. Euclid Chemical Company; Eucon SRA Floor: www.euclidchemical.com/#sle.
      b. Euclid Chemical Company; Eucon SRA-XT: www.euclidchemical.com/#sle.
      c. GCP Applied Technologies; Eclipse Floor 200: www.gcpat.com/#sle.
      d. GCP Applied Technologies; Eclipse 4500: www.gcpat.com/#sle.
      e. Substitutions: See Section 1-06.7.

L. Shrinkage Compensating Admixture: For on-site production of concrete with ASTM C845, Type K cement.
   1. Products:
      a. CTS Cement Manufacturing Corporation; Komponent: www.ctscement.com/#sle.
      b. Substitutions: See Section 1-06.7.

M. Shrinkage Compensating Admixture with Fiber Reinforcement: For on site production of concrete with ASTM C845, Type K cement with integral fiber reinforcement.
   1. Products:
      a. CTS Cement Manufacturing Corporation; System K: www.ctscement.com/#sle.
      b. Substitutions: See Section 1-06.7.

N. Corrosion Inhibiting Admixture:
   1. ASTM C494, Type C.
   2. ASTM C1582.
   3. Products:
      a. Euclid Chemical Company; EUCON CIA: www.euclidchemical.com/#sle.
      b. GCP Applied Technologies; DCI: www.gcpat.com/#sle.
      c. GCP Applied Technologies; DCI S: www.gcpat.com/#sle.
      d. Hycrete, Inc;: www.hycrete.com/#sle.
      e. Substitutions: See Section 1-06.7.

O. Microbiologically-Induced Corrosion Inhibiting Admixture: Resists growth of bacteria and fungi on or inside concrete.
   1. Products:
      a. ConShield Technologies, Inc;: www.conshield.com/#sle.
      b. Penetron; Penetron BioMIC Solutions AEM5772: www.penetron.com/#sle.
      c. Substitutions: See Section 1-06.7.

P. Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties.
   1. Admixture Composition: Crystalline, functioning by growth of crystals in capillary pores.
   2. Admixture Composition: Hydrophobic polymer waterproofing and corrosion inhibitor, functioning by closing concrete pores and chemical bonding.
   3. Permeability of Cured Concrete: No measurable leakage when tested in accordance with COE CRD-C 48 at 200 psi ; provide test reports.
   4. Potable Water Contact Approval: National Science Foundation (NSF) certification for use on structures holding potable water, based on testing in accordance with NSF 61 and NSF 372
   5. Products:
      a. Aquafin, Inc: www.aquafin.net/#sle.
      b. Barrier One Concrete Admixtures; WPX Water Proofer: www.barrierone.com/#sle.
      c. ConShield Technologies, Inc: www.conshield.com/#sle.
      d. Euclid Chemical Company; Eucon Vandex AM-10: www.euclidchemical.com/#sle.
      e. Hycrete, Inc: www.hycrete.com/#sle.
      f. ISE Logik Industries, Inc; CWPA 800: www.iselogik.com/#sle.
      g. Kryton International, Inc; Krystol Internal Membrane (KIM): www.kryton.com/#sle.
      h. Penetron; PENETRON ADMIX SB: www.penetron.com/#sle.
      i. Specialty Products Group; Vapor Lock 20/21: www.spggogreen.com/#sle.
      j. W. R. Meadows, Inc; ADI-CON CW Plus: www.wrmeadows.com/#sle.
      k. Xypex Chemical Corporation; XYPEX Admix C-500: www.xypex.com/#sle.
      l. Substitutions: See Section 1-06.7.

2.05 ACCESSORY MATERIALS

A. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Grout: Comply with ASTM C1107.
   2. Height Change, Plastic State; when tested in accordance with ASTM C827:
      a. Maximum: Plus 4 percent.

b. Minimum: Plus 1 percent.
3. Minimum Compressive Strength at 48 Hours, ASTM C109: 2,000 pounds per square inch
4. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
5. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: 7,000 pounds per square inch.
6. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
7. Products containing aluminum powder are not permitted.
8. Flowable Products:
   a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
   b. Euclid Chemical Company; NS GROUT: www.euclidchemical.com/#sle.
   c. Five Star Products, Inc; Five Star Fluid Grout 100: www.fivestarproducts.com/#sle.
   d. Kaufman Products Inc; SureGrout: www.kaufmanproducts.net/#sle.
   e. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; DURAGROUT: www.laticrete.com/our-products/concrete-construction-chemicals/#sle.
   f. SpecChem, LLC; SC Precision Grout: www.specchemllc.com/#sle.
   g. SpecChem, LLC; SpecRock: www.specchemllc.com/#sle.
   h. W. R. Meadows, Inc; 588-10K: www.wrmeadows.com/#sle.
   i. W. R. Meadows, Inc; 1428 HP: www.wrmeadows.com/#sle.
   j. W. R. Meadows, Inc; CG-86: www.wrmeadows.com/#sle.
   k. W. R. Meadows, Inc; Speed-E-Roc: www.wrmeadows.com/#sle.
   l. Substitutions: See Section 1-06.7.
9. Low-Slump, Dry Pack Products:
   a. Euclid Chemical Company; DRY PACK GROUT: www.euclidchemical.com/#sle.
   b. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
   c. Five Star Products, Inc; Five Star Grout: www.fivestarproducts.com/#sle.
   d. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; Duragrout: www.lmcc.com/#sle.
   e. SpecChem, LLC; SC Multipurpose Grout: www.specchemllc.com/#sle.
   f. W. R. Meadows, Inc; PAC-IT: www.wrmeadows.com/#sle.
   g. Substitutions: See Section 1-06.7.

B. Self-Leveling Cementitious Concrete Floor Topping:
1. Minimum Compressive Strength at 28 Days, ASTM C1708: 7,000 pounds per square inch.
2. Products:
   a. LATICRETE International, Inc; LATICRETE SUPERCAP SC650-MC: www.laticrete.com/#sle.
   b. LATICRETE International, Inc; NXT Level SP: www.laticrete.com/#sle.
   c. Substitutions: See Section 1-06.7.

2.06 BONDING AND JOINTING PRODUCTS

A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059, Type II.
1. Products:
   a. Euclid Chemical Company; AKKRO-7T: www.euclidchemical.com/#sle.
   b. Kaufman Products Inc; SureBond: www.kaufmanproducts.net/#sle.
   c. Kaufman Products Inc; SureWeld: www.kaufmanproducts.net/#sle.
   d. SpecChem, LLC; Strong Bond Acrylic Bonder: www.specchemllc.com/#sle.
   e. W. R. Meadows, Inc; ACRY-LOK-: www.wrmeadows.com/#sle.
   f. Substitutions: See Section 1-06.7.

B. Waterstops: As indicated on drawings.

C. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch (13 mm) deep sealant pocket after removal.
1. Material: ASTM D1751, cellulose fiber.
2. Material: ASTM D1752, sponge rubber (Type I).
3. Material: ASTM D8139, semi-rigid, closed-cell polypropylene foam.
4. Material: Closed-cell, non-absorbent, compressible polymer foam in sheet form.

5. Products:
    a. Nomaco, Inc; Nomaflex Expansion Joint Filler with Void Cap Option: www.nomaco.com/#sle.
    b. Nomaco, Inc; Fastflex Slab Isolation Joint Filler with Tear-Off Strip: www.nomaco.com/#sle.
    c. W. R. Meadows, Inc; Fiber Expansion Joint Filler with Snap-Cap: www.wrmeadows.com/#sle.
    d. W. R. Meadows, Inc; Deck-O-Foam Joint Filler with pre-scored top strip: www.wrmeadows.com/#sle.
    e. W. R. Meadows, Inc; Ceramar Joint Filler with Snap-Cap: www.wrmeadows.com/#sle.
    f. Substitutions: See Section 1-06.7.

D. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.
    1. Products:
        a. W. R. Meadows, Inc; Speed-E-Joint: www.wrmeadows.com/#sle.
        b. Substitutions: See Section 1-06.7.

E. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches on center; ribbed steel stakes for setting.
    1. Provide removable plastic cap strip that forms wedge-shaped joint for sealant installation.
    2. Height: To suit slab thickness.
    3. Manufacturers:
        a. BoMetals, Inc: www.bometals.com/#sle.
        b. Substitutions: See Section 1-06.7.

F. Dowel Sleeves: Plastic sleeve for smooth, round, steel load-transfer dowels.
    1. Manufacturers:
        a. BoMetals, Inc;: www.bometals.com/#sle.
        b. Substitutions: See Section 1-06.7.

G. Plate Dowel System: Steel plate dowel and plastic dowel sleeve; with integral fasteners for attachment to formwork.
    1. Manufacturers:
        a. BoMetals, Inc;: www.bometals.com/#sle.
        b. Substitutions: See Section 1-06.7.

2.07 CURING MATERIALS

A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
    1. Products:
        a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
        b. Euclid Chemical Company ; EUCOBAR: www.euclidchemical.com/#sle.
        c. Kaufman Products Inc; VaporAid: www.kaufmanproducts.net/#sle.
        d. Nox-Crete Inc; Monofilm: www.nox-crete.com/#sle.
        e. SpecChem, LLC; SpecFilm Concentrate or SpecFilm: www.specchemllc.com/#sle.
        f. W. R. Meadows, Inc ; Evapre or Evapre-RTU: www.wrmeadows.com/#sle.
        g. Substitutions: See Section 1-06.7.

B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.
    1. Application: Use at concrete slabs on grade.
    2. Product dissipates within 4 to 6 weeks.
    3. Provide product containing fugitive red dye.
    4. Products:
        a. Dayton Superior Corporation;: www.daytonsuperior.com/#sle.

b. Euclid Chemical Company; COLOR-CRETE CURE AND SEAL VOC: www.euclidchemical.com/#sle.
c. Kaufman Products Inc; Thinfilm 420 Resin Base: www.kaufmanproducts.net/#sle.
d. Nox-Crete Inc; Res-Cure DH 100: www.nox-crete.com/#sle.
e. Sinak Corporation; Cure3D 1000: www.sinak.com/#sle.
f. SpecChem, LLC; SpecRez: www.specchemllc.com/#sle.
g. W. R. Meadows, Inc; 1100-Clear: www.wrmeadows.com/#sle.
h. Substitutions: See Section 1-06.7.

C. Curing Agent, Water-Cure Equivalent Type: Clear, water-based, non-film-forming, liquid-water cure replacement agent.
1. Application: Use at concrete slabs on grade.
2. Comply with ASTM C309 standards for water retention.
3. Compressive Strength of Treated Concrete: Equal to or greater than strength after 14-day water cure when tested according to ASTM C39.
4. VOC Content: Zero.
5. Products:
a. Sinak Corporation; LithiumCure 1000: www.sinak.com/#sle.
b. Sinak Corporation; LithiumCure 2000: www.sinak.com/#sle.
c. Substitutions: See Section 1-06.7.

D. Curing Agent, Densifier, and Trowelling Aid: Penetrating, moisture-retaining, densifying, and workability-extending system spray-applied to wet concrete and floated or troweled into the surface.
1. Product:
a. Green Umbrella Architectural Concrete Systems: GreenIce Curing System: www.greenumbrellasystems.com/#sle.
b. Substitutions: See Section 1-06.7.

E. Moisture-Retaining Sheet: ASTM C171.
1. Curing paper, regular.
2. Polyethylene film, white opaque, minimum nominal thickness of 4 mil, 0.004 inch.
3. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard.
4. Products:
a. Transhield, Inc; Topcure: www.transhield-usa.com/#sle.
b. Substitutions: See Section 1-06.7.

F. Polyethylene Film: ASTM D2103, 4 mil, 0.004 inch thick, clear.

G. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
1. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with ACI recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

D. Normal Weight Concrete:
1. Compressive Strength, when tested in accordance with ASTM C39 at 28 days: As indicated on structural drawings.
2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
3. Calcined Pozzolan Content: Maximum 10 percent of cementitious materials by weight.
4. Silica Fume Content: Maximum 5 percent of cementitious materials by weight.
5. Cement Content: As indicated on structural drawings.
6. Water-Cement Ratio: Maximum 40 percent by weight.

7. Total Air Content: 4 percent, determined in accordance with ASTM C173.
8. Maximum Slump: As indicated on structural drawings.
9. Maximum Aggregate Size: As indicated on structural drawings .

2.09 MIXING

A. Transit Mixers: Comply with ASTM C94.

B. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

C. Do not use expansive component in same concrete batch with MVRA or PIA.

D. Do not use shrinkage-reducing admixture (SRA) in same concrete batch with MVRA or PIA.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

D. Prepare existing concrete surfaces to be repaired according to ICRI 310.2R.

E. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
   1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
   2. Use latex bonding agent only for non-load-bearing applications.

F. Where new concrete with integral waterproofing is to be bonded to previously placed concrete, prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions. Saturate cold joint surface with clean water, and remove excess water before application of coat of waterproofing admixture slurry. Apply slurry coat uniformly with semi-stiff bristle brush at rate recommended by waterproofing manufacturer.

G. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Fabricate and handle reinforcing in accordance with ASTM D3963.

B. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

C. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

D. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

C. Place concrete with shrinkage-compensating expansive component in accordance with ACI PRC-223.

D. Notify Architect not less than 24 hours prior to commencement of placement operations.

E. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

F. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

G. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

H. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.05 SLAB JOINTING

A. Locate joints as indicated on drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
   1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.

D. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.

E. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing. Saw cut dimensions to be as indicated on the structural drawings.

F. Contraction Joint Devices: Use preformed joint device, with top set flush with top of slab.

G. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

3.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. An independent testing agency, as specified in Section 1-06.2, will inspect finished slabs for compliance with specified tolerances.

B. Maximum Variation of Surface Flatness:
   1. Exposed Concrete Floors: 1/4 inch in 10 feet.
   2. Under Seamless Resilient Flooring: 1/4 inch in 10 feet.
   3. Under Carpeting: 1/4 inch in 10 feet.

C. Correct the slab surface if tolerances are less than specified.

D. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
   1. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15, on-grade only.
   2. Under Thick-Bed Tile: F(F) of 20; F(L) of 15, on-grade only.
   3. Under Carpeting: F(F) of 25; F(L) of 20, on-grade only.
   4. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25, on-grade only.
   5. Covered Parking Structure: F(F) of 20; F(L) of 15, on-grade only.
   6. Warehouse Floors On Grade: F(F) of 20; F(L) of 15.

E. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155, within 48 hours after slab installation; report both composite overall values and local values for each measured section.

F. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.

G. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.07 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
   1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
   2. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with clean burlap, and keep moist for 36 hours.
   3. Cork Floated Finish: Immediately after form removal, apply grout with trowel or firm rubber float; compress grout with low-speed grinder, and apply final texture with cork float.

D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
   1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI 302.1R; thick floor coverings include quarry tile, ceramic tile, and Portland cement terrazzo with full bed setting system.
   2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
   3. Decorative Exposed Surfaces: Trowel as described in ACI 302.1R; take measures necessary to avoid black-burnish marks; decorative exposed surfaces include surfaces to be stained or dyed, pigmented concrete, surfaces to receive liquid hardeners, surfaces to receive dry-shake hardeners, surfaces to be polished, and all other exposed slab surfaces.
   4. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.

E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

3.08 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than seven days.
   2. High early strength concrete: Not less than four days.

C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.

D. Surfaces Not in Contact with Forms:
   1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
   2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
      a. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 4 days.
      b. Spraying: Spray water over floor slab areas and maintain wet.
      c. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
   3. Final Curing: Begin after initial curing but before surface is dry.
      a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.
      b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.09 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 1-06.2.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

E. Compressive Strength Tests: ASTM C39, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.

F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143.

H. Slab Testing: Cooperate with manufacturer of specified moisture vapor reducing admixture (MVRA) to allow access for sampling and testing concrete for compliance with warranty requirements.

I. Permeability Test: Test concrete with waterproofing admixture according to COE CRD-C 48.

3.10 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.11 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION 03 30 00

This page intentionally left blank

SECTION 03 35 43
POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes polished concrete finishing.
   1. Multi-step grinding, chemical treatment for hardening, multi-step polishing, and finishing treatment for protection for existing concrete slabs.
   2. Patching and repair prior to polishing.

B. Related Requirements:
   1. Section 03 30 00 "Cast-in-Place Concrete" for concrete materials, coordination of mix design, aggregates, placements procedures, and curing requirements for concrete slabs indicated for polished concrete finish.

1.02 DEFINITIONS

A. Design Reference Sample: Sample designated by Contracting Agency in the Contract Documents that reflects acceptable surface quality and appearance of polished concrete.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Cast-in-place concrete subcontractor.
      e. Polished concrete finishing Subcontractor.
   2. Review curing procedures, construction joints, joint finishing, concrete repair procedures, concrete finishing, and protection of polished concrete.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: For each type of product.

C. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.

D. Qualification Data: For Installer.

E. Material Certificates: For each of the following, signed by manufacturers:
   1. Repair materials.
   2. Liquid floor treatments.

1.05 QUALITY ASSURANCE

A. Special Finish Concrete Work: Performed by expert entity having in-depth knowledge of a wide variety of finish methods and equipment suitable for the type of finish in the locations required for the Work. Applicator shall be approved by the manufacturer of the required finishing system and have a successful record of experience with this finish process and the equipment proposed for the Work. Submit documentation for five previous projects including equipment and methods used and the name of the equipment operator(s), complete information on the finishing process and photographic documentation of finishing from original surface to completion.
   1. Individual in Responsible Control: For work of this Section have ACI Craftsman Certification as Commercial/Industrial Flatwork Specialist - High Tolerance; individual shall be on site at all times work is actively in progress.

B. Field Sample Panels: After approval of verification sample and before casting concrete, produce field sample panels to demonstrate the approved range of selections made under

Sample submittals. Produce a minimum of three sets of full-scale panels, approximately 48 by 48 inches minimum, to demonstrate the expected range of finish, color, and appearance variations.

1. Locate panels as indicated or, if not indicated, as directed by Contracting Agency.
2. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
3. Demolish and remove field sample panels when directed.

C. Mockups: Before casting concrete, build mockups to verify selections made under Sample submittals and to demonstrate color, typical joints, surface finish, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Contracting Agency.
2. Demonstrate curing, finishing, and protecting of polished concrete.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. See Section 1-06.8 for additional mock-up requirements.

1.06 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. General: Installer is responsible for coordinating concrete mix designs, placement, finishing procedures and any other concrete related items impacting finishing for concrete floors to receive polished concrete finishing. For architectural polished concrete finishing provide a floor finish meeting.

B. Polish Level: Provide polished concrete surfaces meeting the following criteria, as determined by Concrete Sawing and Drilling Assoc. (CSDA) standard CSDA-ST-115 Measuring Concrete Micro Surface Texture:

1. Surface Texture Grade (STG): B-3; 64 microinches (µin).
2. Surface Grade: Hone Smooth.
3. Final Grit: 400 grit; high sheen.

C. Aggregate Level: Provide polished concrete surfaces meeting the following criteria, as determined by Concrete Polishing Assoc. of America. (CPAA) standard:

1. Class B: 1/16-inch approximate depth of cut.
2. Fine Aggregate; Fine aggregate exposure with little or no medium aggregate exposure at random locations.

D. Clarity and Gloss: Provide polished concrete surfaces meeting the following criteria, as determined by Concrete Polishing Assoc. of America. (CPAA) standard:

1. Clarity/ Gloss Level: Level 2 to 3, dependent upon approved mockup.
2. Reflective Clarity: Not less than 50 as tested per ASTM D 5767.
3. Reflective Sheen (Gloss): 30-40 as tested per ASTM D 523.

E. Finished Surface Coefficient of Friction: Not less than 0.60 Static Coefficient of Friction (SCOF) and 0.40 Dynamic Coefficient of Friction (DCOF) on non-sloped surfaces as tested per ANSI/ NFSI B101.1 and B101.3.

F. Stain-Resistant: Shall provide stain resistance as defined in ASTM D 1308.

2.02 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.

1. Liquid floor treatments shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation

of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Basis-of-Design Finishing System: Retroplate Concrete Polishing System by Retroplate; www.retroplatesystem.com.

C. Other Acceptable Finishing Systems:
   1. Euco Diamond Hard by Euclid Chemical Co.; www.euclid.com.
   2. Hiperfloor Commercial Finish by Husqvarna; www.husqvarna.com.
   3. FGS PermaShine by L&M Construction Chemicals, Inc., Div. of Laticrete International, Inc.; www.fgs-permashine.com.
   4. Consolideck System by Prosoco, Inc.; www.prosoco.com.
   5. Sasa Galaxy System by Sase Company; https://sasecompany.com.

D. Polish Level, Aggregate Level, Clarity and Gloss: Refer to Performance Requirements articles above.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prior to starting work identify floor finishing values of slab in each area where diamond polish finish is required and verify compliance with requirements in Section 03 30 00 "Cast-in-Place Concrete". Correct areas that deviate beyond specified tolerance until they are brought into compliance.
   1. Utilize grout mortar forced into the pore structure of the concrete substrate to fill cracks and surface imperfections.
   2. Provide coordination with subsequent work to ensure finished concrete is without damage and deterioration at Substantial Completion.

B. Joints: Coordinate joint location and installation with work of Section 03 30 00 "Cast-in-Place Concrete"; provide for joint treatments as work of this Section.
   1. Utilize compressible joint filler to fill joints to prevent the infiltration of debris and provide support for sealants applied to the exposed surface; refer to Section 07 92 00 "Joint Sealants" for requirements.

3.02 POLISHING

A. General: Avoid hand tools to greatest extent possible for consistent finish and control. Grind, hone and polish using grits required to achieve approved finish.

B. Apply penetrating liquid floor treatment to cured and prepared slabs to match approved mockup.

C. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
   1. Perform finishing operations in as continuous an operation as possible. Provide uniform appearance throughout the finished Work.
   2. Provide edge grinding at floor and ramp perimeters, and at stair treads and risers.

D. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.

E. Continue polishing with progressively finer-grit diamond polishing pads to finish level specified, to match approved mockup.
   1. Provide edge polishing at floor and ramp perimeters and stair treads and risers.
   2. Control and dispose of waste produced by grinding and polishing operations.
   3. Neutralize and clean polished floor surfaces.

F. Apply liquid floor sealer to ground, treated and polished slabs to match approved mockup.

3.03 CLEANING AND PROTECTION

A. Clean and protect floor finishes from damage during remaining construction period.

B. Coordinate subsequent work to ensure finished concrete is free from damage and deterioration at Substantial Completion.

END OF SECTION 03 35 43

SECTION 03 47 13
TILT-UP CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tilt-up, site cast concrete wall panels, load bearing, erected from forms to final position.

B. Site cast tilt-up concrete units other than wall panels.

C. Supports, devices, load bearing supports, and attachments.

D. Grouting under panels.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 – Cast-in-Place Concrete: Requirements for concrete for tilt-up panels.

B. Section 03 30 00 – Cast-in-Place Concrete: Requirements for casting slab.

C. Section 03 30 00 – Cast-in-Place Concrete: Requirements for liquid densifiers and hardeners.

D. Section 05 50 00 – Metal Fabrications: Miscellaneous metal for embedment.

E. Section 07 21 00 – Thermal Insulation: Requirements for integral insulation.

F. Section 07 62 00 – Sheet Metal Flashing and Trim: Requirements for reglets recessed in units.

G. Section 07 92 00 – Joint Sealants: Sealing perimeter and intermediate joints.

H. Section 09 90 00 – Painting and Coating: Field applied painting of tilt-up panels.

1.03 REFERENCE STANDARDS

A. ACI 301 – Specifications for Concrete Construction 2020.

B. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete 2009.

C. ACI 305R – Guide to Hot Weather Concreting 2020.

D. ACI 306R – Guide to Cold Weather Concreting 2016.

E. ACI 318 – Building Code Requirements for Structural Concrete 2021.

F. ASHRAE (FUND) – ASHRAE Handbook – Fundamentals Most Recent Edition Cited by Referring Code or Reference Standard.

G. ASHRAE Std 90.1 I-P – Energy Standard for Buildings Except Low-Rise Residential Buildings Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. ASTM A36 – Standard Specification for Carbon Structural Steel 2019.

I. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

J. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

K. ASTM A184 – Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement 2019.

L. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.

M. ASTM A563 – Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric) 2021a.

N. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2022.

O. ASTM A706 – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement 2022.

P. ASTM A767 – Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement 2019.

Q. ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2018a.

R. ASTM C1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete 2018.

S. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field 2021a.

T. ASTM C33 – Standard Specification for Concrete Aggregates 2018.

U. ASTM C78 – Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading) 2022.

V. ASTM C827 – Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures 2016.

W. ASTM C94 – Standard Specification for Ready-Mixed Concrete 2022.

X. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete 2020.

Y. ASTM C150 – Standard Specification for Portland Cement 2022.

Z. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete 2020.

AA. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete 2016.

BB. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete 2019.

CC. ASTM C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2022.

DD. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2020.

EE. ASTM C1289 – Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board 2022.

FF. ASTM F436 – Standard Specification for Hardened Steel Washers Inch and Metric Dimensions 2019.

GG. AWS B2.1 – Specification for Welding Procedure and Performance Qualification 2021.

HH. AWS D1.1 – Structural Welding Code – Steel 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene not later than one week prior to commencing work of this section.

1.05 SUBMITTALS

A. See Section 1-06 for submittal requirements.

B. Product Data: Submit manufacturers' current data on manufactured items used, including recommended methods of installation, relevant installation limitations, and safety precautions.

C. Compatibility Statement: Submit certification that all admixtures, bond breakers, curing compounds, and other accessory materials are compatible with one another and expressly intended for proposed use.

D. Shop Drawings: Indicate layout, tilt-up unit locations, configuration, unit identification marks, reinforcement, integral insulation, insulated panel system connectors, connection details, support items, location of lifting devices, dimensions, openings, and relationship to adjacent components.

E. Proposed Mix Design: Submit proposed mix design for each tilt-up unit type before starting work, complying with Section 1-06 for quality requirements.

F. Laboratory Reports: Submit certified laboratory test reports confirming physical characteristics of materials used in performance of the Work of this section.

G. Designer's Qualification Statement.

H. Panel Fabricator's Qualification Statement.

I. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1 and dated no more than 12 months before start of scheduled welding work.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with ACI 318.

B. Maintain one copy of quality assurance standards on project site.

C. Designer Qualifications: Design units under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

D. Fabricator Qualifications: Company specializing in site-cast tilt-up concrete construction with minimum 5 years of documented experience.
   1. Membership: Member in good standing of the Tilt-Up Concrete Association.

E. Welding Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1 and no more than 12 months before start of scheduled welding work.

1.07 MOCK-UP

A. Provide mock-up panel as quality control for architectural finishes, coordination of work with other sections, testing, and observation of operation.
   1. Panel Size: Minimum 4 by 8 feet, using forming system and construction methods to be used on project.
   2. Details: Incorporate typical edge and reveal conditions as detailed.
   3. Finishes: Demonstrate full range of color, texture, and inserts to be expected in completed panels.
   4. Architectural Liners: Incorporate vertical and horizontal liner joints in mock-up.
   5. Construction Joints: Cast mock-up over slab joint or column joint if actual panels will be affected by such condition.

B. Locate where directed and maintain approved mock-up for comparison to finished work.

C. Mock-up may not remain as part of the Work.
   1. Dispose of mock-up when directed by Architect.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Handling Tilt-up Units: Lift units to position, consistent with their shape and design. Lift and support only from support points.

B. Blocking and Lateral Support During Erection: Use materials that are clean and non-staining. Provide temporary lateral support to prevent bowing, warping, or cracking.

C. Protect units from staining, chipping, or spalling.

1.09 FIELD CONDITIONS

A. Adverse Weather: Do not construct formwork, place reinforcing steel or concrete, or erect panels during adverse weather unless measures acceptable to Architect are taken to prevent damage.

B. Cold Weather: Comply with provisions of ACI 306R for freezing or near-freezing conditions.
   1. Provide adequate equipment for heating and protecting concrete materials.
   2. Do not use concrete materials, reinforcing steel, forms, fillers, ground surface, or other materials that are frozen, frost-covered or that contain ice.
   3. If shelters are used, do not use fuel that will weaken concrete surfaces.

C. Hot Weather: Comply with provisions of ACI 305R for high temperature conditions.
   1. During periods of dry winds, low humidity, and other conditions that cause rapid drying, protect fresh concrete with an evaporation retardant or fine fog spray of water applied immediately after screeding and bull floating.
   2. Maintain protection until final finishing and curing compounds are applied.

PART 2 PRODUCTS

2.01 TILT-UP PANEL UNITS

A. Tilt-Up Panel Units:

1. Concrete: Minimum strength as indicated on structural drawings, 28 day strength, air entrained as indicated on structural drawings; comply with ACI 301.
2. Design Loads: Static loads, anticipated dynamic loading, including positive and negative wind loads, thermal movement loads, and erection forces as defined by applicable code.
3. Calculate structural properties of units in accordance with ACI 318.
4. ccommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
5. Provide connections that accommodate building movement and thermal movement and adjust to misalignment of structure without unit distortion or damage.
6. Provide lifting hardware and lifting system appropriate to panel size and configuration.

2.02 PANEL MATERIALS

A. Forms: Design to withstand stresses resulting from concrete casting process and to maintain panels within 1/4 inch deflection limit; construct from steel or wood, rigidly braced and with precise corners.
   1. Include blockouts as required to provide openings detailed on drawings, designed to limit deflection during pouring to maximum of 1/8 inch.
   2. Provide smooth and clean forming surfaces.
   3. Panels may be stacked for ease of casting.
   4. For forms attachment to slab, use non-intrusive glues or adhesives whenever possible, in lieu of nails and bolts.

B. Concrete Materials:
   1. Cement: ASTM C150, Type I – Normal Portland type; gray color.
   2. Aggregates: ASTM C33.
   3. Water: ASTM C1602; clean, potable, and not detrimental to concrete.
   4. Air Entrainment Admixture: ASTM C260.
   5. Admixtures: Air entrainment as specified in Section 03 30 00.

C. Reinforcing Steel: Sizes and spacing as indicated.
   1. Reinforcing Bars: ASTM A615 deformed steel bars, Grade 60.
   2. Reinforcing Bars for Welding: ASTM A706 deformed steel bars.
      a. Provide report of chemical analysis for each heat of the bars.
   3. Welded Wire Reinforcement: ASTM A1064, style and type as indicated.
      a. Supply in flat sheets.
   4. Bar Mats: ASTM A184.

D. Form Bond Breaker: Non-staining, non-discoloring, leaves no residue; compatible with curing compound used on casting slab and with finishes to be applied to cast surfaces.
   1. Composition: Colorless, reactive, water-based or solvent-based compound.
   2. Do not use materials containing wax, silicone, or petroleum-based compounds.
   3. VOC Content: In compliance with applicable local, State, and federal regulations.
   4. Manufacturers:
      a. Nox-Crete Inc; SilcoSeal Classic: www.nox-crete.com/#sle.
      b. Nox-Crete Inc; SilcoSeal EX: www.nox-crete.com/#sle.
      c. Nox-Crete Inc; SilcoSeal LVOC: www.nox-crete.com/#sle.
      d. Nox-Crete Inc; SilcoSeal Select: www.nox-crete.com/#sle.
      e. SpecChem, LLC; Spec Tilt WB: www.specchemllc.com/#sle.
      f. Substitutions: See Section 1-06.7.

E. Curing Compound: Liquid membrane-forming compound complying with ASTM C309, Type I and ID, Class B.
   1. Manufacturers:
      a. SpecChem, LLC; Spec Tilt WB: www.specchemllc.com/#sle.
      b. Substitutions: See Section 1-06.7.

F. Curing Covers: Reusable, impregnated fiber mat with a white or light colored backing, complying with ASTM C171 for reflectivity and moisture retention.

G. Non-Shrink Grout: ASTM C1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Height Change, Plastic State; when tested according to ASTM C827:
      a. Maximum: Plus 4 percent.
      b. Minimum: Plus 1 percent.
   2. Minimum Compressive Strength at 48 Hours: 2,400 psi.
   3. Minimum Compressive Strength at 28 Days: 10,000 psi.
   4. Manufacturers:
      a. SpecChem, LLC; SC Multi-Purpose Grout: www.specchemllc.com/#sle.
      b. Substitutions: See Section 1-06.7.

H. Grout:
   1. Product: As indicated in structural drawings.

2.03 REVEAL AND ACCENT STRIPS

A. Manufacturers:
   1. Nox-Crete Inc; Clean Line Reveal: www.nox-crete.com/#sle.
   2. Substitutions: See Section 1-06.7.

B. Material: Non-staining, non-reactive, high-density PVC.

C. Profile(s): 1/2" thick CLR 5 or as indicated on drawings.

2.04 SUPPORT AND LIFTING DEVICES

A. Lifting Hardware, Connecting, and Support Devices: ASTM A36 steel; hot-dip galvanized in accordance with ASTM A153.
   1. For support of reinforcing steel, plastic-tipped steel or all plastic supports are also acceptable.

B. Miscellaneous Metal Items: Provide inserts, dowels, and other items to be cast into panels as specified in Section 05 50 00, galvanized after fabrication in accordance with ASTM A123.

C. All-Plastic Supports: Provide units of adequate strength, with surface contact of not more than 0.10 sq. inches per contact point, and colored to blend with concrete.

D. Bolts, Nuts, and Washers: ASTM A307 heavy hex bolts, Type A, hot-dip galvanized, with matching ASTM A563 nuts and matching washers.

E. Primer: Zinc rich oil alkyd.

2.05 ACCESSORIES

A. Non-Conduction Connectors for Integral Insulation: Corrosion- and alkali-resistant connectors designed and manufactured for use in insulated composite panels.
   1. Manufacturers:
      a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.

      b. Substitutions: See Section 1-06.7.

B. Bearing Pads: High density plastic, 1/8 inch thick, smooth both sides.

C. Reglets: Specified in Section 07 62 00.

D. Joint Sealants: Specified in Section 07 92 00.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building structure, anchors, devices, and openings are ready to receive work of this section.

B. Verify that casting slab is cured and ready for work of this section. Fill cracks, saw cuts, joints, or defects that would adversely affect appearance of tilt-up panels.

3.02 PREPARATION

A. Coordinate site cast tilt-up operations with work of other sections to expedite the Work and avoid omissions and delays.

B. Apply bondbreaker to casting slab in accordance with manufacturer's recommendations.

C. Provide for erection procedures and induced loads during erection, and provide for temporary bracing that will remain in place until roof diaphragm has been completely installed and connected.

3.03 FORMING PANELS

A. General: Maintain environmental records and quality control program during production of tilt-up units. Make records available upon request.

B. Lay out panels in manner that will minimize joints in panel faces. Coordinate installation of inserts and anchorages.

C. Use form liners in accordance with manufacturer's instructions.

D. Maintain consistent quality during construction of forms.

E. Fabricate connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment.

F. Embed reinforcing steel, anchors, inserts plates, angles, and other cast-in items as indicated.

G. Cast rigid insulation into units when indicated on drawings.

H. Place and embed flashing reglets in continuous lengths without gaps, and properly positioned. Refer to Section 07 62 00.

I. Locate hoisting devices to permit removal after erection.

J. Work concrete thoroughly around reinforcement, around embedded items, and into corners of the forms. Consolidate concrete in accordance with ACI recommendations.

K. Cold joints are not permitted in any individual panel.

3.04 PLACING AND CURING CONCRETE

A. Mix and deliver concrete in accordance with ASTM C94, Option A, and in compliance with recommendations of ACI 304R.

B. Protect freshly placed concrete from premature drying and excessively hot or cold temperatures.

C. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.

D. Apply liquid membrane curing compound in accordance with manufacturer's recommendations.

E. Moist Curing:

1. Cover panels completely with burlap strips immediately after finishing. Quickly and completely wet entire exposed surface.

2. Cover panels with curing covers to prevent evaporation, and keep covered for seven days. Do not allow alternate wetting and drying.

F. Minor patching is acceptable, providing structural adequacy and appearance of units are not impaired.

3.05 FINISHING CONCRETE

A. Finish exposed surfaces of panels as indicated on drawings.

B. Grade A – Architectural Finish:

1. Panel surfaces must be free of voids, holes, pockets, and other surface deformations greater than 1/8 inch and must not telegraph imperfections from the casting surface, including floor joints.
2. Cracks in excess of 1/32 inch width are not acceptable.
3. Reveals may not deviate from their correct position by more than 1/8 inch in 10 feet.
4. Repairs must not be apparent from a minimum distance of 10 feet.

C. Interior Finish: Floated.

D. Painting: Prepare surfaces to be painted as specified in Section 09 90 00.

3.06 SITE FABRICATION TOLERANCES

A. Unless otherwise approved by Architect, provide panels complying with casting tolerances as specified below.

B. Panel Height and Width:
   1. Up to 20 feet: 1/4 inch maximum.
   2. 20 to 30 feet: 3/8 inch maximum.
   3. Each additional 10 ft increment: 1/8 inch maximum.

C. Panel Thickness: 3/16 inch maximum average variation through any vertical or horizontal cross section.

D. Skew of Panel or Opening: Measured as difference in length of the two diagonals:
   1. Per 6 feet of diagonal dimension: 1/8 inch maximum.
   2. Maximum total difference: 1/2 inch.

E. Panel Openings:
   1. Size: 1/4 inch maximum.
   2. Location of Centerline: 1/4 inch maximum.

F. Location and Placement of Embedded Items:
   1. Inserts, Bolts, and Pipe Sleeves: 3/8 inch.
   2. Lifting and Bracing Inserts: As specified by manufacturer.
   3. Weld Plate Embedments: 1 inch for location; 1/4 inch for tipping and flushness.

3.07 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 1-06.2, will perform concrete mix testing.

B. Take minimum of 4 cylinders and 4 beams for each 150 cubic yds or fraction thereof, of each class of concrete, for each day concrete is cast, or not less than once for each 5000 sq ft of panel area. Field cure test specimens.
   1. Beams: Perform casting, curing, and testing in accordance with ASTM C78. Test two beams prior to panel erection, and average results to determine flexural strength. Retain remaining beams for additional testing, if required.
   2. Cylinders: Make and cure test cylinders in accordance with ASTM C31. Test two cylinders at 7 days and two at 28 days.

C. Take one slump tests for every set of concrete test cylinders in accordance with ASTM C143.

D. Take one air entrainment test cylinder for each set of exterior concrete test cylinders taken.

E. Submit copies of test reports within 24 hours of test, indicating location of panels for each set of test results.

3.08 ERECTION

A. Before beginning erection operations, verify that site conditions are appropriate for the work. Mark elements to comply with designations indicated on approved shop drawings.

B. Employ erection equipment that will prevent damage to existing construction, permanent floor slabs, and tilt-up panels. Protect panels to prevent staining, warping, or cracking.

C. Set panels in assigned positions. Erect members level and plumb within allowable tolerances. Grout space under panels for full bearing, or provide additional support until subsequent grouting operations are completed.

D. Align and maintain uniform horizontal and vertical joints, as erection progresses.

E. When members require adjustment beyond design or tolerance criteria, discontinue affected work; advise Architect.

F. Fasten units in place with mechanical connections.

G. Weld units in place. Perform welding, including tack welds, in accordance with AWS D1.1.

H. Provide non-combustible shields during welding operations.

I. Touch-up field welds and scratched or damaged galvanized surfaces.

J. Brace panels not attached to building frame at time of erection, using a bracing system designed to resist wind and other applicable loads until all structural connections have been made. Provide minimum of two braces per panel and maintain connections daily.

K. Set units dry, without grout, attaining joint dimension with lead or plastic spacers. Grout pack base of unit.

L. Exposed Joint Dimension: 1/2 inch. Adjust units as required to bring joint dimensions within allowable tolerances.

M. Patch holes, cut-off anchors, surface defects, and damaged corners to match panel with epoxy/cement paste adhesive.

N. After panel erection, patch holes or other blemishes in casting slab that were caused by the panel casting or erection processes, using techniques acceptable to Architect.

3.09 ERECTION TOLERANCES

A. Unless otherwise approved by Architect, install site-cast tilt-up panels within erection tolerances as specified below.

B. Replace panels that cannot be installed within specified tolerances.

C. Joint Width Variation:
   1. Up to 20 feet tall panels: 1/4 inch maximum.
   2. Each additional 10 ft increment: 1/8 inch maximum.
   3. Do not increase or decrease joint width more than 50 percent from specified joint width in any case, as measured between panels at exterior face.

D. Joint Taper:
   1. Up to 20 feet (6 m) tall panels: 1/4 inch maximum.
   2. Each additional 10 ft increment: 1/8 inch maximum.
   3. Maximum for entire length of panel: 3/8 inch width difference for non-parallel panel edges.

E. Panel Alignment:
   1. Horizontal and Vertical Joints: 1/4 inch maximum.
   2. Offset in Adjacent Exterior Panel Faces: 1/4 inch.

3.10 PROTECTION

A. Protect units from damage by subsequent construction activities.

END OF SECTION 03 47 13

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural steel framing members.

B. Structural steel support members.

C. Base plates and miscellaneous steel.

D. Grouting under base plates.

1.02 RELATED REQUIREMENTS

A. Section 05 31 00 – Steel Decking: Support framing for small openings in deck.

B. Section 05 50 00 – Metal Fabrications: Steel fabrications affecting structural steel work.

1.03 REFERENCE STANDARDS

A. AISC (MAN) – Steel Construction Manual 2017.

B. AISC 303 – Code of Standard Practice for Steel Buildings and Bridges 2016.

C. ASTM A1 – Standard Specification for Carbon Steel Tee Rails 2018.

D. ASTM A36 – Standard Specification for Carbon Structural Steel 2019.

E. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

F. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished 2018.

G. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

H. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

I. ASTM A242 – Standard Specification for High-Strength Low-Alloy Structural Steel 2018.

J. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.

K. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.

L. ASTM A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2021.

M. ASTM A563 – Standard Specification for Carbon and Alloy Steel Nuts 2021a.

N. ASTM A759 – Standard Specification for Carbon Steel Crane Rails 2021.

O. ASTM A992 – Standard Specification for Structural Steel Shapes 2020.

P. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2020.

Q. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength 2020.

R. AWS A2.4 – Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.

S. AWS B2.1 – Specification for Welding Procedure and Performance Qualification 2021.

T. AWS D1.1/D1.1M – Structural Welding Code – Steel 2022.

U. IAS AC172 – Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172 2019.

V. SSPC-Paint 15 – Steel Joist Shop Primer/Metal Building Primer 2004.

W. SSPC-Paint 20 – Zinc-Rich Coating (Type I – Inorganic, and Type II – Organic) 2019.

X. SSPC-SP 1 – Solvent Cleaning 2015, with Editorial Revision (2016).

Y. SSPC-SP 2 – Hand Tool Cleaning 2018.

Z. SSPC-SP 3 – Power Tool Cleaning 2018.

AA. SSPC-SP 5 – White Metal Blast Cleaning 2007.

BB. SSPC-SP 6 – Commercial Blast Cleaning 2007.

CC. SSPC-SP 7 – Brush-Off Blast Cleaning 2007.

DD. SSPC-SP 10 – Near-White Metal Wet Abrasive Blast Cleaning 2015.

EE. SSPC-SP 11 – Power-Tool Cleaning to Bare Metal 2020.

FF. SSPC-SP 13 – Surface Preparation of Concrete 2018.

GG. UL (FRD) – Fire Resistance Directory Current Edition.

1.04 SUBMITTALS

A. See Section 1-06 for submittal requirements.

B. Shop Drawings:
   1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
   2. Connections not detailed.
   3. Indicate cambers and loads.
   4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.

D. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.

E. Fabricator Test Reports: Comply with ASTM A1011.

F. Materials Test Reports: Submit independent test results or engineered performance analysis of structural thermal-break pad performance in bearing or slip-critical connections where shear and moment loads are applied.

G. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1 and dated no more than 12 months before start of scheduled welding work.

H. Designer's Qualification Statement.

I. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."

B. Maintain one copy of each document on site.

C. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience.

D. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1 and no more than 12 months before start of scheduled welding work.

E. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

F. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Angles and Plates: ASTM A36.

B. Steel W Shapes and Tees: ASTM A992.

C. Rolled Steel Structural Shapes: ASTM A992.

D. Crane Rails: ASTM A1, end hardened, ultrasonic tested, with size as specified by crane manufacturer.

E. Crane Rails: ASTM A759, high strength alloy, head-hardened, heat-treated, ends hardened, ends chamfered, ends prepared for welding, with size as specified by crane manufacturer.

F. Steel Plates and Bars: ASTM A572, Grade 50 high-strength, columbium-vanadium steel.

G. Cold-Formed Structural Tubing: ASTM A500, Grade B.

H. Hot-Formed Structural Tubing: ASTM A501, seamless or welded.

I. Steel Plate: ASTM A514.

J. Pipe: ASTM A53, Grade B, Finish black.

K. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.

L. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153 Class C.

M. Tension Control Bolts: Twist-off type; ASTM F3125.

N. Unheaded Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563 nuts and ASTM F436 Type 1 washers.

O. Headed Anchor Rods: ASTM F1554 Grade 36, plain.

P. Load Indicator Washers: Provide washers complying with ASTM F959 at connections requiring high-strength bolts.

Q. Welding Materials: AWS D1.1; type required for materials being welded.

R. Grout: ASTM C1107; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
   2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
   3. Height Change, Plastic State; when tested according to ASTM C827:
      a. Maximum: Plus 4 percent.
      b. Minimum: Plus 1 percent.

S. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

T. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Shop fabricate to greatest extent possible.

B. Space shear stud connectors as shown on structural drawings.

C. Continuously seal joined members by continuous welds. Grind exposed welds smooth.

D. Fabricate connections for bolt, nut, and washer connectors.

E. Develop required camber for members.

2.03 FINISH

A. Prepare structural component surfaces in accordance with SSPC-SP 3.

B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.

C. Galvanize structural steel members as indicated on drawings to comply with ASTM A123. Provide minimum 1.7 oz/sq ft galvanized coating.

2.04 SOURCE QUALITY CONTROL

A. Provide shop testing and analysis of structural steel.

B. High-Strength Bolts: Provide verification of shop-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts,".

C. Welded Connections: Visually inspect all shop-welded connections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

A. Erect structural steel in compliance with AISC 303.

B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Field weld components and shear studs indicated on shop drawings.

D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".

E. Do not field cut or alter structural members without approval of Architect.

F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

G. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for non-shrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 1-06.2 for quality requirements**.**

B. High-Strength Bolts: Provide verification of field-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts,".

C. Welded Connections: Visually inspect all field-welded connections.

END OF SECTION 05 12 00

SECTION 05 31 00
STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof deck.

B. Supplementary framing for openings up to and including 18 inches.

C. Bearing plates and angles.

1.02 RELATED REQUIREMENTS

A. Section 05 12 00 - Structural Steel Framing: Support framing for openings larger than 18 inches.

B. Section 05 12 00 - Structural Steel Framing: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.

1.03 REFERENCE STANDARDS

A. ASTM A36 - Standard Specification for Carbon Structural Steel 2019.

B. AWS B2.1 - Specification for Welding Procedure and Performance Qualification 2021.

C. AWS D1.1 - Structural Welding Code - Steel 2022.

D. ICC-ES AC43 - Acceptance Criteria for Steel Deck Roof.

E. ICC-ES AC70 - Acceptance Criteria for Fasteners Power Driven into Concrete, Steel and Masonry Elements 2016.

F. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks 2007.

G. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 2004.

H. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic) 2019.

I. UL (FRD) - Fire Resistance Directory Current Edition.

1.04 SUBMITTALS

A. See Section 1-06 for submittal requirements.

B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.

C. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.

D. Certificates: Certify that products furnished meet or exceed specified requirements.

E. Submit manufacturer's installation instructions.

F. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1 and dated no more than 12 months before start of scheduled welding work.

G. Designer's Qualification Statement.

H. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

A. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1 and AWS D1.3 and dated no more than 12 months before start of scheduled welding work.

B. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

C. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Cut plastic wrap to encourage ventilation.

B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Deck:
   1. Canam Steel Corporation: www.canam-steeljoists.ws.
   2. Cordeck, Inc: www.cordeck.com/#sle.
   3. Nucor-Vulcraft Group: www.vulcraft.com/#sle.
   4. Substitutions: See Section 1-06.7.

2.02 STEEL DECK

A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.
   1. Calculate to structural working stress design and structural properties specified.
   2. Maximum Vertical Deflection of Floor Deck: 1/360 of span.
   3. Maximum Vertical Deflection of Roof Deck: 1/240 of span.

B. Roof Deck: Non-composite type, fluted steel sheet:
   1. Galvanized Steel Sheet: ASTM A653, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
      a. Grade as required to meet performance criteria.
   2. Primer: Shop coat of manufacturer's standard primer paint over cleaned and phosphatized substrate.
   3. Structural Properties: As indicated on structural drawings.
   4. Minimum Base Metal Thickness: As indicated on structural drawings.
   5. Nominal Height: 1-1/2 inch.
   6. Profile: Fluted; SDI NR.
   7. Formed Sheet Width: 24 inch.
   8. Side Joints: Lock seam.
   9. End Joints: Lapped, welded.

2.03 ACCESSORY MATERIALS

A. Bearing Plates and Angles: ASTM A36 steel, galvanized per ASTM A123.

B. Welding Materials: AWS D1.1.

C. Fasteners: Galvanized hardened steel, self tapping.

D. Powder Actuated Mechanical Fasteners: Steel; with knurled shank and forged ballistic point. Comply with applicable requirements of ICC-ES AC70.
   1. Design Requirements: Provide number and type of fasteners that comply with the applicable requirements of SDI (DM) design method for roof deck and floor deck applications and ICC-ES AC43.
   2. Material: Steel; ASTM A510.
      a. Hardness: Rockwell C 54.5, minimum.
      b. Tensile Strength: 285 kips per square inch (1965 MPa), minimum.
      c. Shear Strength: 175 kips per square inch (1205 MPa), minimum.
      d. Washers:
         1) Steel Bar Joist Framing Applications: 0.472 inch diameter, minimum.
         2) Exposed Roof Deck Applications: 0.591 inch diameter, minimum.
      e. Corrosion Resistance:
         1) Exposed Roof Deck Applications: Provide manufacturer's standard stainless steel sealing caps with bonded neoprene washer over each fastener.
   3. Products:

a. Simpson Strong-Tie: www.strongtie.com/#sle.
b. Substitutions: See Section 1-06.7.

E. Mechanical Fasteners: Steel; hex washer head, self-drilling, self-tapping.
1. Design Requirements for Sidelap Connections: Provide number and type of fasteners that comply with the applicable requirements of SDI (DM) design method for roof deck and floor deck applications and ICC-ES AC43.
2. Fasteners for Steel Roof Decks Protected with Waterproofing Membrane: ASTM B633, SC1, Type III zinc electroplate.
3. Fasteners for Exposed Steel Roof Deck Application: Manufacturer's standard stainless steel with bonded neoprene washer.
4. Products:
a. ITW Commercial Construction North America; ITW CCNA-Buildex Teks Select Series: www.ITWBuildex.com/#sle.
b. Substitutions: See Section 1-06.7.

F. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.

G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

I. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

J. Acoustical Insulation: Glass fiber type, minimum 1.1 lb/cu ft density; profiled to suit deck.

2.04 FABRICATED DECK ACCESSORIES

A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gauge, 0.0299 inch (0.76 mm) thick sheet steel; of profile and size as indicated; finished same as deck.

B. Cant Strips: Formed sheet steel, , 45 degree slope, 3-1/2 inch nominal width and height, flange for attachment.

C. Roof Sump Pans: Formed sheet steel, 14 gauge, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.

B. On concrete surfaces provide minimum 4 inch bearing.

C. On steel supports provide minimum 1-1/2 inch bearing.

D. Fasten deck to steel support members at ends and intermediate supports at 12 inches on center maximum, parallel with the deck flute and at each transverse flute using methods specified.
1. Welding: Use fusion welds through weld washers.
2. Place and secure special deep fluted sections for integral concrete bridging.

E. Clinch lock seam side laps.

F. At mechanically fastened male/female side laps fasten at 24 inches on center maximum.

G. Drive mechanical sidelap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.

H. At welded male/female side laps weld at 18 inches on center maximum.

I. Weld deck in accordance with AWS D1.3.

J. At deck openings from 6 inches to 18 inches in size, provide 2 by 2 by 1/4 inch steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld to deck at each flute.

K. At deck openings greater than 18 inches in size, provide steel angle reinforcement as specified in Section 05 12 00.

L. Where deck changes direction, install 6 inch minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.

M. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

N. Position floor drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

O. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

END OF SECTION 05 31 00

SECTION 05 40 00
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formed steel stud exterior wall and interior wall framing.

B. Exterior wall sheathing.

C. Formed steel joist and purlin framing and bridging.

1.02 RELATED REQUIREMENTS

A. Section 05 31 00 – Steel Decking.

B. Section 06 10 00 – Rough Carpentry: Wood blocking and miscellaneous framing.

C. Section 07 21 00 – Thermal Insulation: Insulation within framing members.

D. Section 07 25 00 – Weather Barriers: Water-resistive barrier over sheathing.

E. Section 07 62 00 – Sheet Metal Flashing and Trim: Head and sill flashings.

F. Section 07 92 00 – Joint Sealants.

G. Section 09 21 16 – Gypsum Board Assemblies: Lightweight, non-load bearing metal stud framing.

1.03 REFERENCE STANDARDS

A. AISI S100 – North American Specification for the Design of Cold-Formed Steel Structural Members 2020.

B. ANSI A208.1 – American National Standard for Particleboard 2022.

C. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

D. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

E. ASTM A1008 – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.

F. ASTM A1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.

G. ASTM C208 – Standard Specification for Cellulosic Fiber Insulating Board 2022.

H. ASTM C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2022.

I. ASTM C955 – Standard Specification for Cold-Formed Steel Structural Framing Members 2018, with Editorial Revision.

J. ASTM C1007 – Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories 2020.

K. ASTM C1177 – Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2017.

L. ASTM C1289 – Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board 2022.

M. ASTM C1396 – Standard Specification for Gypsum Board 2017.

N. AWS B2.1 – Specification for Welding Procedure and Performance Qualification 2021.

O. AWS D1.1 – Structural Welding Code – Steel 2022.

P. AWS D1.3 – Structural Welding Code – Sheet Steel 2018.

Q. ICC-ES AC38 – Acceptance Criteria for Water-Resistive Barriers 2016, with Editorial Revision (2019).

R. PS 1 – Structural Plywood 2019.

S. SSPC-Paint 15 – Steel Joist Shop Primer/Metal Building Primer 2004.

T. SSPC-Paint 20 – Zinc-Rich Coating (Type I – Inorganic, and Type II – Organic) 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.05 SUBMITTALS

A. See Section 1-06 for submittal requirements.

B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria and limitations.

C. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.

D. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
   1. Indicate stud and ceiling joist layout.
   2. Describe method for securing studs to tracks and for bolted framing connections.
   3. Details for factory-made framing connectors.

E. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

F. Designer's Qualification Statement.

G. Manufacturer's Qualification Statement.

H. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1 and dated no more than 12 months before the start of scheduled welding work.

I. SSMA Manufacturer Qualification: Submit documentation of manufacturer association membership.

J. SSFSA Manufacturer Qualification: Submit documentation of manufacturer association membership.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.

B. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.

C. Manufacturer Qualifications: Member of Supreme Steel Framing System Association (SSFSA): www.ssfsa.com/#sle.

D. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1 and AWS D1.3 and dated no more than 12 months before start of scheduled welding work.

E. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing:
   1. CEMCO: www.cemcosteel.com/#sle.
   2. ClarkDietrich: www.clarkdietrich.com/#sle.
   3. Jaimes Industries: www.jaimesind.com/#sle.
   4. MarinoWARE: www.marinoware.com/#sle.
   5. SCAFCO Corporation: www.scafco.com/#sle.
   6. Steel Construction Systems: www.steelconsystems.com/#sle.

7. The Steel Network, Inc: www.SteelNetwork.com/#sle.
8. Substitutions: See Section 1-06.7.

B. Framing Connectors and Accessories:
1. Same manufacturer as metal framing.
2. ClarkDietrich: www.clarkdietrich.com/#sle.
3. MarinoWARE: www.marinoware.com/#sle.
4. Simpson Strong-Tie: www.strongtie.com/#sle.
5. Substitutions: See Section 1-06.7.

2.02 FRAMING SYSTEM

A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

B. Design Requirements: Provide completed framing system having the following characteristics:
1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100.
2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
3. Design Loads: In accordance with structural drawings and applicable codes.
4. Live load deflection meeting the following, unless otherwise indicated:
a. Floors: Maximum vertical deflection under live load of 1/480 of span.
b. Roofs: Maximum vertical deflection under live load of 1/240 of span.
c. Exterior Walls: Maximum horizontal deflection under wind load of 1/360 of span.
d. Design non-axial loadbearing framing to accommodate not less than 1/2 in vertical deflection.
5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

C. Shop fabricate framing system to the greatest extent possible.

D. Deliver to project site in largest practical sections.

2.03 FRAMING MATERIALS

A. Studs and Track: ASTM C955; track in matching nominal width and compatible height.
1. Gauge and Depth: As scheduled on drawings.
2. Galvanized in accordance with ASTM A653, G90/Z275 coating.
3. Painted finish.
4. Products:
a. CEMCO; ProX Header: www.cemcosteel.com/#sle.
b. MarinoWARE; StudRite: www.marinoware.com/#sle.
c. MBA Building Supplies; Structural Studs & Track: www.mbastuds.com/#sle.
d. Super Stud Building Products, Inc; SuperMAXX Studs: www.buysuperstud.com/#sle.
e. Substitutions: See Section 1-06.7.

B. Jamb Studs: Engineered, C-shaped with wide flanges, designed to replace conventional double-stud framing at openings.
1. Products:
a. SCAFCO Corporation; Kwik-Jamb Studs: www.scafco.com/#sle.
b. Substitutions: See Section 1-06.7.

C. Header: Engineered one-member or two-member assembly, with wide flanges, designed to replace conventional box or nested header framing at openings.
1. Jamb Mounting Clips: Manufacturer's standard.
2. Cripple Stud Clips: Manufacturer's standard.
3. Products:
a. SCAFCO Corporation; HD Header: www.scafco.com/#sle.

b. Substitutions: See Section 1-06.7.

D. Joists and Purlins: Fabricated from ASTM A653 steel sheet, with G90/Z275 hot dipped galvanized coating.
1. Base Metal: Structural Steel (SS), Size as indicated on structural drawings.
2. Gauge and Depth: As indicated on drawings.
3. Products:
a. MarinoWARE; JoistRite: www.marinoware.com/#sle.
b. Super Stud Building Products, Inc; SuperMAXX Joists: www.buysuperstud.com/#sle.
c. Substitutions: See Section 1-06.7.

E. Framing Connectors: Factory-made, formed steel sheet.
1. Material: ASTM A653 SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gauge, 0.1345 inch, and factory punched holes and slots.
2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100.
3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
a. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
b. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
c. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 10 feet.
d. Provide top track with long leg track and head of wall movement connectors; minimum track length of 10 feet.
e. Products:
1) ClarkDietrich; Drift FastClip Slide Clip D-FCSC: www.clarkdietrich.com/#sle.
2) ClarkDietrich; FastClip Slide Clip FCSC: www.clarkdietrich.com/#sle.
3) MarinoWARE; Slotted Track: www.marinoware.com/#sle.
4) MBA Building Supplies; Slotted Track: www.mbastuds.com/#sle.
5) Simpson Strong-Tie; SCB Side-Clip Connector: www.strongtie.com/#sle.
6) Super Stud Building Products, Inc; Deflection Clips: www.buysuperstud.com/#sle.
7) Substitutions: See Section 1-06.7.
4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.
a. Products:
1) Simpson Strong-Tie: www.strongtie.com/#sle.
2) Substitutions: See Section 1-06.7.
5. Wall Stud Bridging Connections: Provide mechanical load-transferring devices that accommodate wind load torsion and weak axis buckling induced by axial compression loads. Provide bridging connections where indicated on the drawings.
6. Products:
a. ClarkDietrich; Spazzer 5400 Bridging Bar: www.clarkdietrich.com/#sle.
b. ClarkDietrich; FastBridge Clip: www.clarkdietrich.com/#sle.
c. Simpson Strong-Tie; SUBH Bridging Connector: www.strongtie.com/#sle.
d. Substitutions: See Section 1-06.7.

2.04 FASTENERS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153.
1. Products:

a. ITW Commercial Construction North America; ITW CCNA-Buildex Teks Select Series: www.ITWBuildex.com/#sle.
b. Substitutions: See Section 1-06.7.

B. Anchorage Devices: Powder actuated.

C. Welding: Comply with AWS D1.1.

2.05 WALL SHEATHING

A. Plywood; PS 1, Grade C-D, Exposure I.

B. Glass mat faced gypsum board; ASTM C1177, square long edges, 5/8 inch thick, Type X – Fire Resistant.

2.06 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.

B. Plates, Gussets, Clips: Formed Sheet Steel, thickness determined for conditions encountered; finish to match framing components.

C. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I – Inorganic, complying with VOC limitations of authorities having jurisdiction.

E. Water-Resistive Barrier: See Section 07 25 00.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION OF STUDS

A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.

B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches on center. Coordinate installation of sealant with floor and ceiling tracks.

C. Place studs at 12 inches on center; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using clip and tie method.

D. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.

E. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.

F. Install load-bearing studs, brace, and reinforce to develop full strength and achieve design requirements.

G. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

H. Install intermediate studs above and below openings to align with wall stud spacing.

I. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.

J. Attach cross studs to studs for attachment of fixtures anchored to walls.

K. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

L. Touch-up field welds and damaged primed surfaces with primer.

3.03 INSTALLATION OF JOISTS AND PURLINS

A. Install framing components in accordance with manufacturer's instructions.

B. Make provisions for erection stresses. Provide temporary alignment and bracing.

C. Place joists as indicated on the drawing and not more than 2 inches from abutting walls, and connect joists to supports using fastener method.

D. Set floor and ceiling joists parallel and level, with lateral bracing and bridging.

E. Locate joist end bearing directly over load-bearing studs or provide load distributing member to top of stud track.

F. Provide web stiffeners at reaction points.

G. Touch-up field welds and damaged primed surfaces with primer.

3.04 INSTALLATION OF WALL SHEATHING

A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.
   1. Provide fiberboard wall sheathing at least 32 inches wide at building corners, measured horizontally.
   2. Provide steel diagonal bracing at corners with foam insulation or gypsum board wall sheathing.
   3. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges, and ends.

3.05 TOLERANCES

A. Maximum Variation from True Position: 1/4 inch.

B. Maximum Variation of any Member from Plane: 1/4 inch.

END OF SECTION 05 40 00

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 – Cast-in-Place Concrete: Placement of metal fabrications in concrete.

B. Section 05 12 00 – Structural Steel Framing: Structural steel column anchor bolts.

C. Section 05 31 00 – Steel Decking: Bearing plates for metal deck bearing, including anchorage.

D. Section 05 51 00 – Metal Stairs.

E. Section 05 52 13 – Pipe and Tube Railings.

F. Section 09 90 00 – Painting and Coating: Paint finish.

1.03 REFERENCE STANDARDS

A. AAMA 611 – Voluntary Specification for Anodized Architectural Aluminum 2020.

B. AAMA 2603 – Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2021.

C. AAMA 2604 – Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2021, with Errata (2022).

D. AAMA 2605 – Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2020, with Errata (2022).

E. ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes 2017.

F. ASTM A36 – Standard Specification for Carbon Structural Steel 2019.

G. ASTM A48 – Standard Specification for Gray Iron Castings 2022.

H. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

I. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

J. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

K. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2022.

L. ASTM A283 – Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.

M. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.

N. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.

O. ASTM A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2021.

P. ASTM A554 – Standard Specification for Welded Stainless Steel Mechanical Tubing 2021.

Q. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

R. ASTM A1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.

S. ASTM A666 – Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

T. ASTM B210 – Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes 2019a.

U. ASTM B211 – Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire 2019.

V. ASTM B26 – Standard Specification for Aluminum-Alloy Sand Castings 2018, with Editorial Revision.

W. ASTM B85 – Standard Specification for Aluminum-Alloy Die Castings 2018, with Editorial Revision.

X. ASTM B177 – Standard Guide for Engineering Chromium Electroplating 2011 (Reapproved 2021).

Y. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.

Z. ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.

AA. ASTM B221M – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.

BB. ASTM B633 – Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.

CC. ASTM F3125 – Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2022.

DD. AWS A2.4 – Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.

EE. AWS B2.1 – Specification for Welding Procedure and Performance Qualification 2021.

FF. AWS D1.1 – Structural Welding Code – Steel 2020, with Errata (2022).

GG. AWS D1.2 – Structural Welding Code – Aluminum 2014, with Errata (2020).

HH. IAS AC172 – Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172 2019.

II. SSPC-Paint 15 – Steel Joist Shop Primer/Metal Building Primer 2004.

JJ. SSPC-Paint 20 – Zinc-Rich Coating (Type I – Inorganic, and Type II – Organic) 2019.

KK. SSPC-SP 2 – Hand Tool Cleaning 2018.

1.04 SUBMITTALS

A. See Section 1-06 for submittal requirements.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Submit drawings that include the following, as applicable:
      1) Design criteria.
      2) Member sizes and gauges.
      3) Details of connections.
      4) Bracing requirements.

C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1 and dated no more than 12 months before start of scheduled welding work.

D. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

A. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1 and AWS D1.2 and dated no more than 12 months before start of scheduled welding work.

B. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

2.01 MATERIALS – STEEL

A. Steel Sections: ASTM A36.

B. Steel Tubing: ASTM A501 hot-formed structural tubing.

C. Plates: ASTM A283.

D. Pipe: ASTM A53, Grade B Schedule 40, black finish.

E. Stainless Steel, General: ASTM A666, Type 304.

F. Stainless Steel Tubing: ASTM A554, Type 304, 16 gauge, 0.0625 inch minimum metal thickness, 1-1/2 inch diameter.

G. Stainless Steel Bars, Shapes and Moldings: ASTM A276, Type 304.

H. Slotted Channel Fittings: ASTM A1011.

I. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.

J. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.

K. Bolts, Nuts, and Washers: ASTM F3125, Type 1, plain.

L. Welding Materials: AWS D1.1; type required for materials being welded.

M. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

N. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I – Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by intermittent welds and plastic filler.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FINISHES – STEEL

A. Prime paint steel items.
   1. Exceptions: Galvanize items to be embedded in concrete.
   2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: One coat.

E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123 requirements. Provide minimum 1.7 oz/sq ft galvanized coating.

F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123 requirements.

G. Slotted Channel Framing: ASTM A653, Grade 33.

H. Stainless Steel Finish: No. 4 Bright Polished finish.

2.04 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components as indicated on drawings.

D. Perform field welding in accordance with AWS D1.1.

E. Obtain approval prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 05 50 00

SECTION 05 51 00
METAL STAIRS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stairs with concrete treads.

B. Prefabricated stairs.

C. Structural steel stair framing and supports.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 – Cast-in-Place Concrete: Concrete fill in stair pans; mesh reinforcement for landings.

B. Section 03 30 00 – Cast-in-Place Concrete: Placement of metal anchors in concrete.

C. Section 05 50 00 – Metal Fabrications.

D. Section 05 50 00: Bearing plates for metal stairs, including anchorage.

E. Section 05 52 13 – Pipe and Tube Railings: Metal handrails for the stairs specified in this section.

F. Section 05 52 13 – Pipe and Tube Railings: Metal handrails and balusters other than specified in this section.

G. Section 09 90 00 – Painting and Coating: Paint finish.

1.03 REFERENCE STANDARDS

A. ADA Standards – 2010 ADA Standards for Accessible Design 2010.

B. AISC 201 – AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures 2006.

C. ASCE 7 – Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM A6 – Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling 2021.

E. ASTM A36 – Standard Specification for Carbon Structural Steel 2019.

F. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

G. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

H. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

I. ASTM A283 – Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.

J. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.

K. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.

L. ASTM A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2021.

M. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

N. ASTM A786 – Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates 2015 (Reapproved 2021).

O. ASTM A1008 – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.

P. ASTM A1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.

Q. ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.

R. ASTM B221M – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.

S. ASTM E935 – Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings 2021.

T. ASTM E2072 – Standard Specification for Photoluminescent (Phosphorescent) Safety Markings 2014.

U. ASTM F3125 – Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2022.

V. AWS A2.4 – Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.

W. AWS B2.1/B2.1M – Specification for Welding Procedure and Performance Qualification 2021.

X. AWS D1.1/D1.1M – Structural Welding Code – Steel 2020, with Errata (2022).

Y. IAS AC172 – Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172 2019.

Z. ICC (IBC) – International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

AA. NAAMM AMP 510 – Metal Stairs Manual 1992.

BB. SSPC-Paint 20 – Zinc-Rich Coating (Type I – Inorganic, and Type II – Organic) 2019.

CC. SSPC-SP 2 – Hand Tool Cleaning 2018.

DD. UL 1994 – Luminous Egress Path Marking Systems Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 1-06 for submittal requirements.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Include the design engineer's seal and signature on each sheet of shop drawings.

C. Design Data: As required by authorities having jurisdiction.

D. Design Data, Seismic Performance: Submit documentation that stairs meet performance requirements specified.

E. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1 and dated no more than 12 months before start of scheduled welding work.

F. Designer's Qualification Statement.

G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 201.

H. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1 and dated no more than 12 months before start of scheduled welding work.

C. Fabricator Qualifications:
   1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
   2. A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
   3. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Prefabricated Metal Stairs:
   1. Cutting Edge Steel; Cutting Edge Stair: www.cesteel.com/#sle.
   2. Lapeyre Stair, Inc: www.lapeyrestair.com/#sle.
   3. Pacific Stair Corporation: www.pacificstair.com/#sle.
   4. Precision Ladders, LLC; Aluminum Alternating Tread Stairs: www.precisionladders.com/#sle.
   5. Substitutions: See Section 1-06.7.

2.02 METAL STAIRS – GENERAL

A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
   1. Regulatory Requirements: Provide stairs and railings that comply with most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
   2. Handrails: Comply with applicable accessibility requirements of ADA Standards.
   3. Structural Design: Provide complete stair and railing assemblies that comply with the applicable local code.
      a. Stair Capacity: Uniform live load of 100 lb/sq ft and a concentrated load of 300 lb with deflection of stringer or landing framing not to exceed 1/360 of span.
      b. Railing Assemblies: Comply with applicable local code.
      c. Seismic Performance: Stairs designed to withstand the effects of earthquake motions determined according to ASCE 7.
         1) Component Importance Factor: 1.5.
         2) No permanent inelastic deformation occurs under movements equal 2.5 percent interstory drift, minimum.
   4. Dimensions: As indicated on drawings.
   5. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
   6. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
   7. Separate dissimilar metals using paint or permanent tape.

B. Metal Jointing and Finish Quality Levels:
   1. Service: Exposed joints tight with face surfaces aligned; underside of stair not covered by soffit is not considered exposed to view.
      a. Welded Joints: Welded on back side wherever possible.
      b. Welds Exposed to View: Ground smooth; not required to be flush.
      c. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts or screw threads.
      d. Metal Surfaces to be Painted: Sanded smooth, suitable for satin or matte finish.

C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.03 METAL STAIRS WITH CONCRETE TREADS

A. Jointing and Finish Quality Level: Architectural, as defined above.

B. Risers: Closed.

C. Treads: Metal pan with field-installed concrete fill.
   1. Concrete Depth: 1-1/2 inches, minimum.
   2. Precast Concrete Treads:
      a. Concrete Strength: 5,000 psi at 28 days, minimum.
      b. Air Content: 4 to 6 percent.
      c. Cement Color: Natural gray.
      d. Abrasive Strip: Contrasting color, embedded into surface 1/2 inch back of point of nosing.
      e. Anchorage to Tread Pan: Epoxy adhesive.
   3. Tread Pan Material: Steel sheet.
   4. Tread Pan Thickness: As required by design; 14 gauge, 0.075 inch minimum.
   5. Pan Anchorage to Stringers: Welded or bolted to carrier angles welded or bolted to stringers.
   6. Concrete Reinforcement: Welded wire mesh.

D. Risers: Same material and thickness as tread pans.
   1. Nosing Depth: Not more than 1-1/2 inch overhang.

E. Stringers: Rolled steel channels.
   1. Stringer Depth: Per Drawings.
   2. End Closure: Sheet steel of same thickness as risers welded across ends.

F. Railings: Steel pipe railings.

G. Finish: Shop- or factory-prime painted.

H. Under Side of Stair: Exposed to view, to be finished same as specified for other exposed to view surfaces.

2.04 HANDRAILS AND GUARDS

A. Wall-Mounted Rails: See Section 05 52 13.

B. Guards: Pipe railings, see Section 05 52 13.

2.05 MATERIALS

A. Steel Sections: ASTM A36.

B. Steel Tubing: ASTM A500 or ASTM A501 structural tubing, round and shapes as indicated.

C. Steel Plates: ASTM A6 or ASTM A283.

D. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
   1. Hot-Rolled Steel Sheet: ASTM A1011, Designation CS (commercial steel).
   2. Cold-Rolled Steel Sheet: ASTM A1008, Designation CS (commercial steel).

E. Galvanized Steel Sheet: ASTM A653, Structural Steel (SS) Grade 33/230 with G40/Z120 coating.

2.06 ACCESSORIES

A. Steel Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.

B. Welding Materials: AWS D1.1; type required for materials being welded.

C. Shop and Touch-Up Primer: SSPC-Paint 15, and comply with VOC limitations of authorities having jurisdiction.

D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I – Inorganic, and comply with VOC limitations of authorities having jurisdiction.

2.07 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Prime Painting: Use specified shop- and touch-up primer.
   1. Preparation of Steel: In accordance with SSPC-SP 2 Hand Tool Cleaning.
   2. Number of Coats: One.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. When field welding is required, clean and strip primed steel items to bare metal.

B. Supply items required to be cast into concrete and embedded in masonry with setting templates.

3.03 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.

C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1.

E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.

F. Obtain approval prior to site cutting or creating adjustments not scheduled.

G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION 05 51 00

This page intentionally left blank

SECTION 05 52 13
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall mounted handrails.

B. Stair railings and guardrails.

C. Free-standing railings at steps.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 – Cast-in-Place Concrete: Placement of anchors in concrete.

B. Section 05 51 00 – Metal Stairs: Handrails other than those specified in this section.

C. Section 05 51 00 – Metal Stairs: Attachment plates for handrails specified in this section.

D. Section 09 21 16 – Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

E. Section 09 90 00 – Painting and Coating: Paint finish.

1.03 REFERENCE STANDARDS

A. AAMA 611 – Voluntary Specification for Anodized Architectural Aluminum 2020.

B. AAMA 2603 – Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2021.

C. AAMA 2604 – Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2021, with Errata (2022).

D. AAMA 2605 – Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2020, with Errata (2022).

E. ADA Standards – 2010 ADA Standards for Accessible Design 2010.

F. AISC 201 – AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures 2006.

G. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

H. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

I. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.

J. ASTM A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2021.

K. ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings 2020.

L. ASTM B177 – Standard Guide for Engineering Chromium Electroplating 2011 (Reapproved 2021).

M. ASTM B211 – Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire 2019.

N. ASTM B241 – Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube 2016.

O. ASTM B429 – Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube 2020.

P. ASTM B483 – Standard Specification for Aluminum and Aluminum-Alloy Drawn Tube and Drawn Pipe for General Purpose Applications 2021.

Q. ASTM E935 – Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings 2021.

R. ASTM E2072 – Standard Specification for Photoluminescent (Phosphorescent) Safety Markings 2014.

S. AWS A2.4 – Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.

T. AWS B2.1 – Specification for Welding Procedure and Performance Qualification 2021.

U. AWS D1.1 – Structural Welding Code – Steel 2020, with Errata (2022).

V. AWS D1.6 – Structural Welding Code – Stainless Steel 2017, with Amendment (2021).

W. AWS C3.4 – Specification for Torch Brazing 2016.

X. AWS C3.5 – Specification for Induction Brazing 2016, with Amendment (2017).

Y. AWS C3.9 – Specification for Resistance Brazing 2020.

Z. IAS AC172 – Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172 2019.

AA. SSPC-Paint 15 – Steel Joist Shop Primer/Metal Building Primer 2004.

BB. SSPC-Paint 20 – Zinc-Rich Coating (Type I – Inorganic, and Type II – Organic) 2019.

CC. UL 1994 – Luminous Egress Path Marking Systems Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 1-06 for submittal requirements.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Include the design engineer's seal and signature on each sheet of shop drawings.

C. Samples: Submit two, 6 inch long samples of handrail. Submit two samples of elbow, wall bracket, and end stop.

D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1 and dated within the previous 12 months.

E. Designer's Qualification Statement.

F. Fabricator's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.

C. Fabricator Qualifications:
   1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
   2. A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
   3. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

PART 2 PRODUCTS

2.01 RAILINGS – GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

D. Allow for expansion and contraction of members and building movement without damage to connections or members.

E. Dimensions: See drawings for configurations and heights.
   1. Top Rails and Wall Rails: 1-1/2 inches diameter, round.
   2. Intermediate Rails: 1-1/2 inches diameter, round.
   3. Posts: 1-1/2 inches diameter, round.
   4. Balusters: See Drawings.

F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
   1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
   2. For anchorage to stud walls, provide backing plates, for bolting anchors.

G. Welded Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
   1. Ease exposed edges to a small uniform radius.
   2. Welded Joints:
      a. Carbon Steel: Perform welding in accordance with AWS D1.1.

2.02 STEEL RAILING SYSTEM

A. Steel Tube: ASTM A500 Grade B cold-formed structural tubing.

B. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

C. Exposed Fasteners: No exposed bolts or screws.

D. Straight Splice Connectors: Steel concealed spigots.

E. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:
   1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
   2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
   3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Weld connections that cannot be shop welded due to size limitations.
   1. Weld in accordance with AWS D1.1.
   2. Match shop welding and bolting.
   3. Clean welds, bolted connections, and abraded areas.
   4. Touch up shop primer and factory-applied finishes.
   5. Repair galvanizing with galvanizing repair paint per ASTM A780.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

C. Apply one coat of bituminous paint to concealed aluminum surfaces that will be in contact with cementitious or dissimilar materials.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Install railings in compliance with ADA Standards for accessible design at applicable locations.

D. Anchor railings securely to structure.

E. Field weld anchors as indicated on drawings. Touch-up welds with primer. Grind welds smooth.

F. Conceal anchor bolts and screws.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 05 52 13

SECTION 05 75 10
PERFORATED METAL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior fabrications made of formed metal sheet including:
   1. Perforated metal panel for accessory structures.

1.02 REFERENCE STANDARDS

A. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes 2017.

B. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip 2022a.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2023.

D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.

E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.

F. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.

G. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

H. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements 2022.

I. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs 2022.

J. ASTM F594 - Standard Specification for Stainless Steel Nuts 2022.

1.03 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data - Sheet Metal Material: Manufacturer's data for perforated metal panels and finish.
   1. Storage and handling requirements and recommendations.

C. Verification Samples: For each finish product specified, minimum size 12 inches (305 mm) square, representing actual product in color and texture.

D. Maintenance Data: Care of finishes and warranty requirements.

1.04 QUALITY ASSURANCE

A. Mock-Up: Provide a mock-up for evaluation of fabrication workmanship.
   1. Provide products finished as specified.
   2. Mock-up may remain as part of the Work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Package for protection against transportation damage.
   2. Provide markings to identify components consistently with drawings.
   3. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
   1. Store in well-ventilated space out of direct sunlight.
   2. Protect from moisture and condensation with tarpaulins or other suitable weathertight covering installed to provide ventilation.
   3. Store at a slope to ensure positive drainage of accumulated water.

4. Do not store in enclosed space where ambient temperature can exceed 120 degrees F (49 degrees C).
5. Avoid contact with other materials that might cause staining, denting, or other surface damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Perforated Metal Panel Manufacturers:
1. McNichols: www.mcnichols.com/#sle.
2. Ametco® Manufacturing Corporation: www.ametco.com/#sle.
3. Direct Metals: www.directmetals.com/#sle.
4. Substitutions: See Section 1-06.7.

2.02 PERFORATED METAL PANELS

A. Material: Alloy 3003-H14 (3003H14).
1. Thickness: .0500" Thick (16 Gauge).
2. Sheet size: 48 by 120 (1219 by 2438 by 3048 mm).
3. Perforations:
a. Round: 3/16" round on 1/4" staggered centers (60° staggered centers) with straight rows parallel to length of sheet.
b. End Pattern: Sheared through both ends.
4. Basis of Design Panel: McNichols 1731145041

2.03 FORMED METAL FABRICATIONS - GENERAL

A. Shop Assembly: Preassemble items to greatest extent possible. Minimize field splices and field assembly. Disassemble only as necessary for transportation and handling. Mark items clearly for assembly and installation.

B. Coordination: Match dimensions and attachment of formed metal items to adjacent construction. Produce integrated assemblies. Closely fit joints; align edges and flat surfaces unless indicated otherwise.

C. Ease exposed edges to small uniform radius.

D. Performance Requirements:
1. Thermal Movements:
a. Allow for thermal movements in exterior metal fabrications due to temperature changes. Prevent buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
b. Temperature Change Range: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), on material surfaces.
2. Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

2.04 FORMED METAL FABRICATIONS - SHEET METAL

A. Closures and Trim:
1. Form closures from type and thickness of metal indicated.
2. Conceal fasteners when possible.
3. Drill and tap holes for securing to other surfaces.
4. Miter or cope at corners and reinforce with bent metal plate. Form tight joints.

2.05 MATERIALS

A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections exposed to view on finished units.

B. Aluminum Sheet: ASTM B209/B209M, 3003-H14 minimum; alloy and temper recommended by aluminum producer and finisher for use and finish indicated.

C. Anchors, Clips and Accessories: Use one of the following:
1. Stainless steel complying with ASTM A276/A276M, ASTM A480/A480M, or ASTM A666.
2. Exterior Locations or in Contact with Stainless Steel:

a. Bolts: Stainless steel; ASTM F593, Group 1 (A1).
b. Nuts: Stainless steel; ASTM F594.

3. Structural Anchors: Provide anchors where work is indicated to comply with design loads.
   a. Type: Provide chemical or torque-controlled expansion anchors.
   b. Capacity: When tested according to ASTM E488/E488M; four times the load imposed when installed in concrete.

D. Fasteners, General: Same basic metal and alloy as formed metal sheet unless indicated otherwise. Do not use metals incompatible with the materials joined.

E. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 15 mil (0.4 mm) dry film thickness per coat.

F. Joint Sealer, Exterior: ASTM C920; elastomeric silicone sealant; of type, grade, class, and use classifications required to seal joints in decorative formed metal and remain weathertight; and as recommended in writing by decorative formed metal manufacturer.

G. Isolation Coating: Manufacturer's standard alkali-resistant coating.

2.06 FINISHES

A. Aluminum Finishes:
   1. Aluminum Finish: Mill finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and interfaces with other work.

B. Verify substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturer's written instructions.

C. If substrate preparation is the responsibility of another installer, notify Contracting Agency of unsatisfactory preparation before proceeding.

D. Notify Contracting Agency in writing of conditions detrimental to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent work areas and finish surfaces from damage during installation.

B. Deliver anchorage items to be cast into concrete or built into masonry to appropriate installer(s) together with setting templates.

C. Coat concrete and masonry and dissimilar metal surfaces that will be in contact with metal surfaces with bituminous coating.

3.03 INSTALLATION - SHEET METAL AND PLATE FABRICATIONS

A. Locate and place decorative formed sheet metal items level and plumb; align with adjacent construction. Cut, drill and fit as required to install.

B. Do not cut or abrade sheet metal finishes that cannot be completely restored in the field. Return such items to manufacturer or fabricator for required alterations and refinishing or provide new items.

C. Use concealed anchorages where possible. Provide washers where needed on bolts or screws to protect metal surfaces and make weathertight connection.

D. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers indicated.

E. Corrosion Protection: Apply permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with incompatible substrate materials. Prevent corrosion damage to material and finish.

3.04 CLEANING

A. Restore finishes damaged during installation and construction period. Return items that cannot be refinished in the field to manufacturer or fabricator. Refinish entire unit or provide new units.

B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.

C. Remove temporary coverings and protection of adjacent work areas.

D. Clean installed products in accordance with manufacturer's instructions.

3.05 PROTECTION

A. Protect installed products from damage during construction.

END OF SECTION 05 75 10

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural dimension lumber framing.

B. Nonstructural dimension lumber framing.

C. Wall Sheathing.

D. Subflooring.

E. Miscellaneous framing and sheathing.

F. Communications and electrical room mounting boards.

G. Concealed wood blocking, nailers, and supports.

H. Miscellaneous wood nailers, furring, and grounds.

I. Roof underlayment.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Setting anchors in concrete.

B. Section 05 12 00 - Structural Steel Framing: Prefabricated beams and columns for support of wood framing.

C. Section 05 50 00 - Metal Fabrications: Miscellaneous steel connectors and support angles for wood framing.

D. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.

E. Section 07 62 00 - Sheet Metal Flashing and Trim: Sill flashings.

F. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard 2022.

B. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

C. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019.

E. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board 2022.

F. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing 2003 (Reapproved 2017).

G. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2022.

H. ASTM C1177 - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2017.

I. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board 2022.

J. ASTM C1396 - Standard Specification for Gypsum Board 2017.

K. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing 2010 (Reapproved 2017).

L. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2021.

M. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing 2019a.

N. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials 2021a.

O. ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies 2018.

P. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

Q. ASTM E96 - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022.

R. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C 2019a.

S. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).

T. AWPA U1 - Use Category System: User Specification for Treated Wood 2022.

U. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

V. ICC (IECC) - International Energy Conservation Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

W. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers 2016, with Editorial Revision (2019).

X. ICC-ES AC310 - Acceptance Criteria for Water-resistive Membranes Factory-bonded to Wood-based Structural Sheathing, Used as Water-Resistive Barriers 2008, with Editorial Revision (2015).

Y. NELMA (SGR) - Standard Grading Rules for Northeastern Lumber 2021.

Z. PS 1 - Structural Plywood 2009 (Revised 2019).

AA. PS 2 - Performance Standard for Wood Structural Panels 2018.

BB. PS 20 - American Softwood Lumber Standard 2021.

CC. SPIB (GR) - Grading Rules 2014.

DD. WWPA G-5 - Western Lumber Grading Rules 2021.

1.04 SUBMITTALS

A. See Section 1-06 for submittal requirements.

B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.

C. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.

D. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

1.06 WARRANTY

A. See Sections 1-05.10 & 1-06.5 for additional warranty requirements.

B. Correct defective work within a two-year period commencing on Date of Substantial Completion.

C. Manufacturer Warranty: Provide two-year manufacturer warranty for commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Douglas Fir-Larch, unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: Northeastern Lumber Manufacturers Association; NELMA (SGR).

B. Grading Agency: Western Wood Products Association; WWPA G-5.

C. Sizes: Nominal sizes as indicated on drawings, S4S.

D. Moisture Content: S-dry or MC19.

E. Stud Framing (2 by 2 through 2 by 6):
   1. Species: Allowed under referenced grading rules.
   2. Species: Douglas Fir-Larch.
   3. Grade: No. 2.
   4. Products:
      a. Roseburg Forest Products; Stud Length Lumber: www.roseburg.com/#sle.
      b. Substitutions: See Section 1-06.7.

F. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

A. Subflooring: Oriented strand board wood structural panel; PS 2, rated Single Floor.
   1. Bond Classification: Exterior.
   2. Performance Category: 19/32 PERF CAT.
   3. Span Rating: 20.
   4. Edges: Square.
   5. Edges: Tongue and groove.
   6. Surface Finish: Fully sanded face.
   7. Exposure Time: Sheathing will not delaminate or require sanding due to moisture absorption from exposure to weather for up to 200 days.
   8. Provide fastening guide on top panel surface with separate markings indicating fastener spacing for 16 inches, 19.2 inches and 24 inches on center, respectively.
   9. Warranty: Manufacturer's standard lifetime limited warranty against manufacturing defects and that panels will not delaminate or require sanding due to moisture absorption damage from exposure to weather for up to the stated period.
   10. Products:
      a. Georgia-Pacific LLC; DryGuard Enhanced OSB Sub-Floor: www.buildgp.com/#sle.
      b. Huber Engineered Woods, LLC; AdvanTech Flooring with AdvanTech Subfloor Adhesive: www.huberwood.com/#sle.
      c. Louisiana-Pacific Corporation; TopNotch Sub-Flooring 350: www.lpcorp.com/#sle.
      d. Weyerhaeuser Company: www.weyerhaeuser.com/#sle.
      e. Substitutions: Substitutions: See Section 1-06.7.

B. Underlayment: APA Underlayment; plywood, Exposure 2, 3/4 inch thick. Fully sanded faces at resilient flooring.

C. Wall Sheathing: Plywood, PS 1, Grade C-D, Exposure I.

D. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

E. Other Applications:
   1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
   2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.

3. Other Locations: PS 1, C-D Plugged or better.

2.04 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153 for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
   3. Anchors: Toggle bolt type for anchorage to hollow masonry.

B. Die-Stamped Connectors: Hot dipped galvanized steel, sized to suit framing conditions.
   1. For contact with preservative treated wood in exposed locations, provide minimum G185 (Z550) galvanizing complying with ASTM A653.
   2. Products:
      a. Substitutions: See Section 1-06.7.

C. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
   1. For contact with preservative treated wood in exposed locations, provide minimum G185 (Z550) galvanizing complying with ASTM A653.
   2. Products:
      a. Substitutions: See Section 1-06.7.

D. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.

E. Sill Flashing: See Section 07 62 00.

F. Subfloor Adhesives: Gap-filling construction adhesive for bonding wood structural panels to wood-based floor system framing; complying with ASTM D3498.
   1. Products:
      a. Adfast USA Inc; ADBOND EX 5690: www.adfastcorp.com/#sle.
      b. Franklin International, Inc; Titebond Fast Set Polyurethane Construction Adhesive: www.titebond.com/#sle.
      c. Franklin International, Inc; Titebond PROvantage Weatherproof Subfloor Adhesive: www.titebond.com/#sle.
      d. Huber Engineered Woods, LLC; AdvanTech Subfloor Adhesive: www.huberwood.com/#sle.
      e. Substitutions: See Section 1-06.7.

G. General Purpose Construction Adhesives: Comply with ASTM C557.
   1. Products:
      a. Franklin International; Titebond GREENchoice Weatherproof Subfloor Adhesive: www.titebond.com/#sle.
      b. Substitutions: See Section 1-06.7.

H. Water-Resistive Barrier: See Section 07 25 00.

PART 3 EXECUTION

3.01 PREPARATION

A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches and seal.

B. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.

C. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.

C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

F. Provide the following specific nonstructural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.
   4. Grab bars.
   5. Towel and bath accessories.
   6. Wall-mounted door stops.
   7. Chalkboards and marker boards.
   8. Wall paneling and trim.
   9. Joints of rigid wall coverings that occur between studs.

3.04 INSTALLATION OF CONSTRUCTION PANELS

A. Subflooring/Underlayment Combination: Glue and nail to framing; staples are not permitted.

B. Subflooring: Glue and nail to framing; staples are not permitted.

C. Underlayment: Secure to subflooring with nails and glue.
   1. At locations where resilient flooring will be installed, fill and sand splits, gaps, and rough areas.
   2. Place building paper between floor underlayment and subflooring.

D. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
   1. Use plywood or other acceptable structural panels at building corners, for not less than 96 inches, measured horizontally.
   2. Provide inlet diagonal bracing at corners.
   3. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.

E. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.
   4. Size: 48 by 96 inches, installed horizontally at ceiling height.
   5. Size and Location: As indicated on drawings.

3.05 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.

B. Allow preservative to dry prior to erecting members.

3.06 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.07 FIELD QUALITY CONTROL

A. See Section 1-06.2 for additional field quality control and inspection requirements.

3.08 CLEANING

A. Waste Disposal:
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 06 10 00

SECTION 07 11 13
BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bituminous dampproofing.

1.02 RELATED REQUIREMENTS

A. Section 07 21 00 - Thermal Insulation: Rigid insulation board used for slab and foundation insulation.

1.03 REFERENCE STANDARDS

A. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing 2011 (Reapproved 2016).

B. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal 1997 (Reapproved 2018).

C. ASTM D1227/D1227M - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing 2013, with Editorial Revision (2019).

D. ASTM D4479/D4479M - Standard Specification for Asphalt Roof Coatings - Asbestos-Free 2007 (Reapproved 2018).

E. NRCA (WM) - The NRCA Waterproofing Manual 2021.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide properties of primer, bitumen, and mastics.

C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

D. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F (5 degrees C) for 24 hours before and during application until dampproofing has cured.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bituminous Dampproofing Manufacturers:
   1. Karnak Corporation: www.karnakcorp.com/#sle.
   2. Mar-Flex Systems, Inc: www.mar-flex.com/#sle.
   3. W. R. Meadows, Inc: www.wrmeadows.com/#sle.
   4. Substitutions: See Section 1-06.7.

2.02 BITUMINOUS DAMPPROOFING

A. Bituminous Dampproofing: Cold-applied, spray-grade; asphalt base, volatile petroleum solvents, and other content, suitable for application by spray, brush, roller, or squeegee; asbestos-free; suitable for application on vertical and horizontal surfaces.
   1. Composition: ASTM D4479/D4479M Type I, asbestos free.
   2. VOC Content: Not more than permitted by local, State, and federal regulations.
   3. Applied Thickness: 1/16 inch (1.5 mm), minimum, wet film.
   4. Products:
      a. W. R. Meadows, Inc; Sealmastic Spray-Mastic: www.wrmeadows.com/#sle.
      b. Substitutions: See Section 1-06.7.

2.03 BITUMEN MATERIALS

A. Cold Asphaltic Type:
   1. Emulsified Asphalt: ASTM D1227/D1227M, with fiber reinforcement other than asbestos, Type II, Class 1 or 2.
   2. Asphalt Primer: ASTM D41/D41M, compatible with substrate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work.

B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.

C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.02 PREPARATION

A. Protect adjacent surfaces not designated to receive dampproofing.

B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.

C. Do not apply dampproofing to surfaces unacceptable to manufacturer.

D. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

3.03 APPLICATION

A. Foundation Walls: Apply two coats of asphalt dampproofing.

B. Foundation Walls: Patch disturbed areas of existing dampproofing with two additional coats of dampproofing of the same generic type.

C. Perform this work in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.

D. Prime surfaces in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.

E. Prime surfaces at a rate approved by manufacturer for application indicated, and allow primer to dry thoroughly.

F. Apply bitumen by spray application.

G. Apply bitumen at a temperature limited by equiviscous temperature (EVT) plus or minus 25 degrees F (14 degrees C); do not exceed finish blowing temperature for four hours.

H. Apply bitumen in one coat, continuous and uniform, at a rate of 25 sq ft/gal (0.6 sq m/L) per coat.

I. Apply from 2 inches (50 mm) below finish grade elevation down to top of footings.

J. Seal items watertight with mastic, that project through dampproofing surface.

K. Backfill against dampproofing to protect from damage per manufacturer's requirements.

END OF SECTION 07 11 13

SECTION 07 14 00
FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Polyurethane waterproofing.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete substrate.

B. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashing.

1.03 REFERENCE STANDARDS

A. ASTM C836/C836M - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course 2018 (Reapproved 2022).

B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2016 (Reapproved 2021).

C. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015 (Reapproved 2021).

D. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers 2022.

E. NRCA (WM) - The NRCA Waterproofing Manual 2021.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide data for membrane, surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants.

C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.

D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and acceptable installation temperatures.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

G. Warranty Documentation:
   1. Submit manufacturer warranty and ensure that forms have been completed in Contracting Agency's name and registered with manufacturer.
   2. Submit installer's documentation that installation complies with warranty conditions for the field-applied waterproofing.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 MOCK-UPS

A. See Section 1-06.8 for additional mock-up requirements.

B. Construct mock-up consisting of 100 sq ft (10 sq m) of horizontal and vertical fluid-applied waterproofing; to represent finished work including internal and external corners and base flashings.

C. Mock-up may remain as part of work.

1.07 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F (5 degrees C) for 24 hours before and during application and until cured.

1.08 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Installer Warranty: Provide 2-year warranty for waterproofing failing to resist penetration of water commencing on Date of Substantial Completion. Complete forms in Contracting Agency's name and register with installer.

C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Polyurethane Waterproofing:
   1. Master Builders Solutions: www.master-builders-solutions.com/en-us/#sle.
   2. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
   3. Substitutions: See Section 1-06.7.

B. Basis of Design Product:
   1. MasterSeal Traffic 1500 Deck Coating System

2.02 FLUID-APPLIED WATERPROOFING APPLICATIONS

A. Polyurethane Waterproofing:
   1. Location: Level 2 mechanical rooms.

2.03 FLUID-APPLIED WATERPROOFING MATERIALS

A. Polyurethane Waterproofing: Cold-applied, high solids content polyurethane waterproofing complying with ASTM C836/C836M.
   1. Cured Thickness: 60 mil, 0.060 inch (1.52 mm), minimum.
   2. Suitable for installation over wood substrates.
   3. Components: One.
   4. Tensile Strength: 400 psi (2.758 MPa), minimum, measured in accordance with ASTM D412.
   5. Ultimate Elongation: 500 percent, minimum, measured in accordance with ASTM D412.
   6. Durometer Hardness, Type A: 60, minimum, in accordance with ASTM D2240.
   7. Adhesion: 150 psi (1.03 MPa), minimum, measured in accordance with ASTM D4541.

2.04 ACCESSORIES

A. Sealant for Joints and Cracks in Substrate: Type compatible with waterproofing material and as recommended by waterproofing manufacturer.

B. Counterflashings: See Section 07 62 00.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.

C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.

D. Verify that items penetrating surfaces to receive waterproofing are securely installed.

E. Where existing conditions are responsibility of another installer, notify Contracting Agency of unsatisfactory conditions.

F. Do not proceed with this work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent surfaces from damage not designated to receive waterproofing.

B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.

C. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.

D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.

E. Seal moving cracks with sealant and non-rigid filler, using procedures recommended by sealant and waterproofing manufacturers.

3.03 INSTALLATION

A. Install waterproofing to specified minimum thickness in accordance with manufacturers instructions and NRCA (WM) applicable requirements.

B. Apply primer or surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.

C. Apply extra thickness of waterproofing material at corners, intersections, and angles.

D. Seal membrane and flashings to adjoining surfaces.

3.04 PROTECTION

A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION 07 14 00

This page intentionally left blank

SECTION 07 19 00
WATER REPELLENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water repellents applied to exterior, concrete surfaces.

1.02 REFERENCE STANDARDS

A. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units 2022c.

B. ASTM C642 - Standard Test Method for Density, Absorption, and Voids in Hardened Concrete 2021.

C. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings 2005 (Reapproved 2018).

D. ASTM D5095 - Standard Test Method for Determination of the Nonvolatile Content in Silanes, Siloxanes and Silane-Siloxane Blends Used in Masonry Water Repellent Treatments 1991 (Reapproved 2022).

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a meeting at least one week prior to starting work; require attendance of affected installers; invite Contracting Agency and Contracting Agency.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide product description, details of tests performed, limitations, and chemical composition.

C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention; cautionary procedures required during application.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's Field Reports: Report whether manufacturer's "best practices" are being followed; if not, state corrective recommendations. Email report to Contracting Agency the same day as inspection occurs; mail report on manufacturer's letterhead to Contracting Agency within 2 days after inspection.

F. Manufacturer's Qualification Statement.

G. Installer's Qualification Statement.

H. Maintenance Materials: Furnish the following for Contracting Agency's use in maintenance of project.
   1. See Section 1-06.9 for additional maintenance materials and provisions.
   2. Extra Water Repellent Material: Two gallons (9 liters) of type installed.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience

C. Contracting Agency reserves the right to provide continuous independent inspection of surface preparation and application of water repellent.

1.06 MOCK-UPS

A. See Section 1-06.8 for additional mock-up requirements.

B. Prepare representative surface 36 by 36 inches (0.91 by 0.91 m) in size using specified materials and preparation and application methods on surfaces identical to those to be coated; approved mock-up constitutes standard for workmanship.

C. For proposed substitutions, prepare side-by-side mock-ups of specified and substitute products.

D. Mock-up may remain as part of work.

1.07 FIELD CONDITIONS

A. Protect liquid materials from freezing.

B. Do not apply water repellent when ambient temperature is lower than 50 degrees F (10 degrees C) or higher than 100 degrees F (38 degrees C).

C. Do not apply water repellents when wind velocity is higher than 15 mph (24.14 kph).

1.08 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty for sealer and anti-graffiti coating.
   1. Include coverage for degradation of waterproofing ability and reduction in graffiti resistance on designated substrate.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Silane, Siloxane, Silane-Siloxane Blend, and Siliconate Water Repellents:
   1. Evonik Corporation; Protectosil CHEM-TRETE BSM 400 with Protectosil ANTIGRAFFITI: www.evonik.com/#sle.
   2. Substitutions: See Section 1-06.7.

2.02 MATERIALS

A. Water Repellent: Non-glossy, colorless, penetrating, water-vapor-permeable, non-yellowing sealer, that dries invisibly leaving appearance of substrate unchanged.
   1. Applications: Vertical surfaces and non-traffic horizontal surfaces.
   2. Number of Coats: Two.
   3. VOC Content: Less than 600 g/L, when tested in accordance with ASTM D3960 or ASTM D5095.
   4. Moisture Absorption When Applied to Masonry: Five percent, maximum, when tested in accordance with ASTM C140/C140M using masonry sample completely coated with water repellent.
   5. Moisture Absorption When Applied to Concrete: Five percent, maximum, when tested in accordance with ASTM C642 concrete sample completely coated with water repellent.
   6. Maintains dry appearance when wetted.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify joint sealants are installed and cured.

C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of water repellent.

3.02 PREPARATION

A. Protection of Adjacent Work:
   1. Protect adjacent landscaping, property, and vehicles from drips and overspray.
   2. Protect adjacent surfaces not intended to receive water repellent.

B. Prepare surfaces to be coated as recommended by water repellent manufacturer for best results.

C. Do not start work until masonry mortar substrate is cured a minimum of 60 days.

D. Remove loose particles and foreign matter.

E. Remove oil and foreign substances with a chemical solvent that will not affect water repellent.

F. Allow surfaces to dry completely to degree recommended by water repellent manufacturer before starting coating work.

3.03 APPLICATION

A. Apply water repellent in accordance with manufacturer's instructions, using procedures and application methods recommended as producing the best results.

B. Apply at rate recommended by manufacturer, continuously over entire surface.

C. Apply two coats, minimum.

D. Remove water repellent from unintended surfaces immediately by a method instructed by water repellent manufacturer.

E. Provide manufacturer's field service representative to inspect preparation and application work continuously during entire application period to ensure that manufacturer's "best practices" for preparation and application are being followed.

END OF SECTION 07 19 00

This page intentionally left blank

SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation at cavity wall construction, perimeter foundation wall, underside of floor slabs, and over roof deck.

B. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

A. Section 07 53 23 - EPDM Thermoset Single-Ply Roofing: Installation requirements for board insulation over low slope roof deck.

1.03 DEFINITIONS

A. Mineral Fiber Material Composition: Insulation referred to as mineral fiber block, board, and blanket insulation is composed of fibers from mineral based substances such as rock, slag, or glass and processed from the molten state into fibrous form.
   1. Based on type of insulation substance, the material will be referred to as a mineral fiber when having a rock or slag base, and glass fiber with a glass or silica sand base, also considered a mineral.
   2. Insulation blankets are flexible units consisting of felted, bonded, or unbonded fibers formed into rolls or flat cut pieces referred to as batts; rolls are simply longer versions of batts.
   3. For additional information about mineral fiber and the various classification types, refer to the following reference standards; ASTM C553, ASTM C612, ASTM C665, and ASTM C726.

1.04 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).

C. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2022.

D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).

E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.

F. ASTM C726 - Standard Specification for Mineral Wool Roof Insulation Board 2017.

G. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board 2022a.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.

I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).

J. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C 2022.

K. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies 2018.

1.05 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

E. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

F. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of contractor accreditation and installer certification on project site during and after installation. Present on-site documentation upon request.

1.06 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
   1. Installer Qualification: Use accredited contractors, certified installers, evaluated materials, and third-party field quality control audit.
   2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.07 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.

B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.

C. Insulation Over Metal Stud Framed Walls, Continuous: Expanded polystyrene (EPS) board.

D. Insulation on Inside of Concrete and Masonry Exterior Walls: as noted on Drawings.

E. Insulation in Metal Framed Walls: Batt insulation with separate vapor retarder.

F. Insulation Over Roof Deck: Polyisocyanurate board.

2.02 FOAM BOARD INSULATION MATERIALS

A. Expanded Polystyrene (EPS) Board Insulation: Comply with ASTM C578.
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.

B. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.
   1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
   2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   4. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.0 (0.88), minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
   5. Board Edges: Square.
   6. Products:
      a. DuPont de Nemours, Inc; Styrofoam Brand Scoreboard: building.dupont.com/#sle.
      b. Kingspan Insulation LLC; GreenGuard XPS Type IV, 25 psi: www.kingspan.com/#sle.
      c. Owens Corning Corporation; FOAMULAR Type IV Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.
      d. Substitutions: See Section 1-06.7.

C. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, comply with ASTM C1289.

1. Classifications:
    a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
        1) Class 1 - Faced with glass fiber reinforced cellulosic facers on both major surfaces of core foam.
        2) Compressive Strength: Classes 1-2-3, Grade 1 - 16 psi (110 kPa), minimum.
        3) Thermal Resistance, R-value (RSI-value): At 1-1/2 inch (38.1 mm) thick; Class 1, Grades 1-2-3 - 8.4 (1.48), minimum, at 75 degrees F (24 degrees C).
2. Water Vapor Permeance: 1.2 perm (68 ng/(Pa s sqm)), maximum, at 1 inch (25 mm) thickness, and when tested in accordance with ASTM E96/E96M, desiccant method.
3. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
4. Board Thickness: See Drawings.
5. Board Edges: Square.

2.03 MINERAL FIBER BLANKET INSULATION MATERIALS

A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
    1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
    2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
    3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
    4. Formaldehyde Content: Zero.
    5. Facing: Unfaced.
    6. Manufacturers:
        a. CertainTeed Corporation: www.certainteed.com/#sle.
        b. Johns Manville: www.jm.com/#sle.
        c. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
        d. Substitutions: See Section 1-06.7.

B. Mineral Wool Blanket Thermal Insulation: Flexible or semi-rigid preformed insulation, complying with ASTM C665.
    1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
    2. Smoke Developed Index: 50, when tested in accordance with ASTM E84.

2.04 ACCESSORIES

A. Interior Vapor Retarder: Modified polyethylene/polyacrylate (PE/PA) film reinforced with polyethylene terephthalate (PET) fibers, 12 mil, 0.012 inch (0.30 mm) thick.
    1. Width: 4.9 feet (1.5 m).
    2. Products:
        a. SIGA Cover Inc; SIGA-Majrex 200: www.siga.swiss/global_en/#sle.
        b. Substitutions: See Section 1-06.7.

B. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
    1. Application: Sealing of interior circular penetrations, such as pipes or cables.
    2. Width: Are required for application.
    3. Temperature Resistance: Range of minus 40 to 212 degrees F (minus 40 to 100 degrees C).
    4. Products:
        a. SIGA Cover Inc; SIGA-Rissan: www.siga.swiss/global_en/#sle.
        b. Substitutions: See Section 1-06.7.

C. Flashing Tape: Special reinforced film with high performance adhesive.
    1. Application: Window and door opening flashing tape.
    2. Width: As required for application.
    3. Primer: Tape manufacturer's recommended product.

D. Sill Plate Sealer: Closed-cell foam tape with rubberized adhesive membrane; bridges gap between foundation structure and sill plate or skirt board.
    1. Width: 5-1/2 inches (140 mm).

2. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.
3. Products:
   a. Protecto Wrap Company; Triple Guard Energy Sill Sealer: www.protectowrap.com/#sle.
   b. Substitutions: See Section 1-06.7.

E. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.

F. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
1. Length as required for thickness of insulation material and penetration of deck substrate.

G. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT EXTERIOR WALLS

A. Install rigid insulation directly to steel studs or exterior grade sheathing at 16 inches (406 mm) on center with manufacturer recommended mechanical fasteners, and tape joints with manufacturer's minimum 4 inches (102 mm) wide sealant tape; comply with ASTM E2357.

B. Install boards per Drawings on walls.

C. Extend boards over expansion joints, unbonded to wall on one side of joint.

D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

E. Tape insulation board joints.

3.03 BOARD INSTALLATION UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.04 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK

A. Board Installation Over Roof Deck, General:
1. See applicable roofing specification section for specific board installation requirements.
2. Ensure vapor retarder is clean and dry, continuous, and ready for application of roofing system.
3. Fasten insulation to deck in accordance with roofing manufacturer's written instructions and applicable Factory Mutual requirements.
4. Do not apply more insulation than can be covered with roofing on the same day.

3.05 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over face of member

F. Tape seal tears or cuts in vapor retarder.

G. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane; tape seal in place.

3.06 FIELD QUALITY CONTROL

A. See Section 1-06.8 for additional mock-up and quality requirements.

3.07 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 07 21 00

This page intentionally left blank

SECTION 07 25 00
WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water-resistive barriers.

1.02 RELATED REQUIREMENTS

A. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.

1.03 DEFINITIONS

A. Weather Barriers: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.

B. Water-Resistive Barrier: A material behind an exterior wall covering that is intended to resist liquid water that has penetrated behind the exterior covering from further intruding into the exterior wall assembly.

1.04 REFERENCE STANDARDS

A. AATCC Test Method 127 - Test Method for Water Resistance: Hydrostatic Pressure 2018, with Editorial Revision (2019).

B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection 2021.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.

D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).

E. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials 2021a.

F. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers 2016, with Editorial Revision (2021).

G. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components 2023.

1.05 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide data on material characteristics.

C. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

1.06 MOCK-UPS

A. See Section 1-06.8 for additional mock-up requirements.

B. Construct weather barrier mock-up, 20 feet (6.096 m) long by 20 feet (6.096 m) wide, indicating typical penetration opening conditions.

C. Mock-up may not remain as part of work.

1.07 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

PART 2 PRODUCTS

2.01 WATER-RESISTIVE BARRIER MATERIALS

A. Water-Resistive and Air Barrier: Nonwoven, spunbonded polypropylene.
   1. Air Permeance: 0.0011 cfm/sq ft (0.0058 L/(s sq m)), maximum, when tested in accordance with ASTM E2178.

2. Water Vapor Permeance: 54 perms (3,078 ng/(Pa s sq m)), minimum, when tested in accordance with ASTM E96/E96M using Procedure A - Desiccant Method, at 73.4 degrees F (23 degrees C).
3. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 3 months of weather exposure.
4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
5. Seam and Perimeter Tape: As recommended by sheet manufacturer.
6. Products:
   a. DuPont de Nemours, Inc.; Tyvek Commercial Wrap.
   b. Substitutions: See Section 1-06.7.

2.02 ACCESSORIES

A. Sealants, Tapes, and Accessories Used for Sealing Water-Resistive Barrier and Adjacent Substrates: As indicated or complying with water-resistive barrier manufacturer's installation instructions.

B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
   1. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 30 days of weather exposure.
   2. Products:
      a. DuPont de Nemours, Inc; FlexWrap: www.dupont.com/building/#sle.
      b. DuPont de Nemours, Inc; StraightFlash: www.dupont.com/building/#sle.
      c. DuPont de Nemours, Inc; VersaFlange: www.dupont.com/building/#sle.
      d. Substitutions: See Section 1-06.7.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions comply with requirements of this section.

3.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

3.03 INSTALLATION

A. Install materials in accordance with manufacturer's installation instructions.

B. Water-Resistive Barriers: Install continuous water-resistive barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.

C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.

D. Mechanically Fastened Exterior Sheets:
   1. Install sheets shingle-fashion to shed water, with seams aligned horizontal.
   2. Overlap seams as recommended by manufacturer, 6 inches (152 mm), minimum.
   3. Overlap at outside and inside corners as recommended by manufacturer, 12 inches (305 mm), minimum.
   4. Attach to framed construction with fasteners extending through sheathing into framing, and space fasteners at 12 to 18 inches (305 to 460 mm) on center along each framing member supporting sheathing.
   5. For applications indicated to be airtight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners as recommended by manufacturer.
   6. Where stud framing rests on concrete or masonry substrate, extend lower edge of barrier sheets at least 4 inches (102 mm) below bottom of framing and seal to substrate with sealant or approved mounting tape.

7. Install water-resistive barrier over jamb flashings.
8. Install head flashings under water-resistive barrier.
9. At framed openings with frames having nailing flanges, extend sheet into opening and over flanges; at head of opening, seal sheet over flange and flashing.

E. Self-Adhered Sheets/Flashings:
1. Prepare substrate in accordance with sheet manufacturer's installation instructions; fill and tape joints in substrate and between dissimilar materials.
2. Lap sheets/flashings shingle-fashion to shed water and seal laps airtight.
3. Upon placement of sheets/flashings, firmly press onto substrate with resilient hand roller; ensure that laps are firmly adhered with no gaps or fishmouths.
4. Use same material, or other material approved by sheet/flashing manufacturer, to seal sheets to adjacent substrates, and as flashing.
5. At expansion joints, provide transition to joint assemblies approved by sheet/flashing manufacturer.

F. Openings and Penetrations in Exterior Water-Resistive Barriers:
1. Install flashing over sills, covering entire sill framing member, and extend at least 5 inches (127 mm) onto water-resistive barrier and at least 6 inches (152 mm) up jambs; mechanically fasten stretched edges.
2. At openings filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches (100 mm) wide; do not seal sill flange.
3. At openings filled with nonflanged frames, seal water-resistive barrier to each side of framing at opening using flashing at least 9 inches (230 mm) wide, and covering entire depth of framing.
4. At head of openings, install flashing under water-resistive barrier extending at least 2 inches (50 mm) beyond face of jambs; seal water-resistive barrier to flashing.
5. At interior face of openings, seal gaps between window and door frames and rough framing using appropriate joint sealant over backer rod.
6. Service and Other Penetrations: Form flashing around penetrating items and seal to surface of water-resistive barrier.

3.04 FIELD QUALITY CONTROL

A. Do not cover installed water-resistive barriers until required inspections have been completed.

B. Obtain approval of installation from the water-resistive barrier manufacturer representative by review of the mock-up, prior to proceeding with remainder of installation.

C. Take digital photographs of each portion of installation prior to covering up weather barriers.

3.05 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION 07 25 00

This page intentionally left blank

SECTION 07 41 13
METAL ROOF PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal roof panel system of preformed steel panels.

1.02 RELATED REQUIREMENTS

A. Section 05 12 00 - Structural Steel Framing: Roof framing and purlins.

B. Section 07 42 13 - Metal Wall Panels: Preformed wall panels.

C. Section 07 92 00 - Joint Sealants: Sealing joints between metal roof panel system and adjacent construction.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.

B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.

C. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process 2022.

D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection 2021.

E. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference 2005 (Reapproved 2017).

F. ASTM E1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference 1995 (Reapproved 2018).

G. ASTM E1680 - Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems 2016 (Reapproved 2022).

H. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Summary of test results, indicating compliance with specified requirements.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Specimen warranty.

C. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
   1. Show work to be field-fabricated or field-assembled.
   2. Include structural analysis signed and sealed by qualified structural engineer, indicating compliance of roofing system to specified loading conditions.

D. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches (305 mm) square, representing actual roofing metal, thickness, profile, color, and texture.
   1. Include typical panel joint in sample.
   2. Include typical fastening detail.

F. Manufacturer's qualification statement.

G. Installer's qualification statement.

H. Test Reports: Indicate compliance of metal roofing system to specified requirements.

I. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Contracting Agency's name and are registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section and with at least five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 MOCK-UPS

A. See Section 1-06.8 for additional mock-up requirements.

B. Provide mock-up of 40 sq ft (12.19 sq m), including underlayment and associated flashings.

C. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.

B. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.08 FIELD CONDITIONS

A. Do not install metal roof panels, underlayment when surface, ambient air, or wind chill temperatures are below 45 degrees F (7 degrees C).

1.09 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Finish Warranty: Provide 20-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Contracting Agency's name and register with warrantor.

C. Special Warranty: Provide 5-year warranty for weathertightness of roofing system, including agreement to repair or replace metal roof panels that fail to keep out water commencing on the Date of Substantial Completion. Complete forms in Contracting Agency's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Metal Roof/Wall Panels: SpanSeam standing seam roof by AEP Span; https://www.aepspan.com/#sle

B. Architectural Metal Roof Panel Manufacturers:
   1. Metal Roofing Systems, Inc: www.metalroofingsystems.biz/#sle.
   2. Metl-Span, a Division of NCI Group, Inc: www.metlspan.com/#sle.
   3. AEP Span: www.aepspan.com/products/#sle.
   4. Taylor Metal Products: https://taylormetal.com/#sle.
   5. Substitutions: See Section 1-06.7.

2.02 PERFORMANCE REQUIREMENTS

A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:
   1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed L/180 of span length(L) when tested in accordance with ASTM E1592.
      a. Dead Loads: Weight of roofing system.
      b. Live Loads: As indicated on drawings.

2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
3. Wind Uplift: Class 90 wind uplift resistance of UL 580.
4. Air Infiltration: Maximum 0.06 cfm/sq ft (1.1 cu m/hr/sq m) at air pressure differential of 6.24 lbf/sq ft (300 Pa), when tested according to ASTM E1680.
5. Water Penetration: No water penetration when tested in accordance with procedures and recommended test pressures of ASTM E1646; perform test immediately following air infiltration test.
6. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 100 degrees F (56 degrees C).

2.03 METAL ROOF PANELS

A. Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.

B. Metal Panels: Factory-formed panels with factory-applied finish.
   1. Steel Panels:
      a. Aluminum-zinc alloy-coated steel complying with ASTM A792/A792M; minimum AZ50 (AZM150) coating.
      b. Steel Thickness: Minimum 22 gauge, 0.030 inch (0.76 mm).
   2. Profile: Standing seam, with minimum 1.0 inch (25 mm) seam height; concealed fastener system for field seaming with special tool.
   3. Texture: Smooth.
   4. Color: ZincAlume® Plus
   5. Length: Full length of roof slope, without lapped horizontal joints.
   6. Width: Maximum panel coverage of 16 inches (406 mm).

2.04 ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.05 FABRICATION

A. Panels: Provide factory fabricated panels with applied finish and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.

B. Joints: Provide captive gaskets, sealants, or separator strips at panel joints to ensure weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

2.06 FINISHES

A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch (0.023 mm); color and gloss as selected by Architect from manufacturer’s standard line.

2.07 ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, and caps of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.

B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.

C. Sealants:
   1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
   2. Concealed Sealant: Non-curing butyl sealant or tape sealant.

3. Seam Sealant: Factory-applied, non-skinning, non-drying type.

D. Underlayment: Self-adhering polymer modified asphalt sheet complying with ASTM D1970/D1970M, with strippable release film and top surface of woven polypropylene sheet.
   1. Sheet Thickness: 22 mil, 0.022 inch (0.55 mm) minimum total thickness.
   2. Self Sealability: Nail sealability in accordance with ASTM D1970/D1970M.
   3. Products:
      a. Certainteed Roofing; WinterGuard HT - High Temperature Waterproofing Underlayment: www.certainteed.com/#sle.
      b. Henry Company; Blueskin PE200HT: www.henry.com/#sle.
      c. Polyglass USA, Inc; Polystick MTS Self-Adhered High Temperature Roof Underlayment: www.polyglass.us/#sle.
      d. Substitutions: See Section 1-06.7.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Contracting Agency of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Broom clean wood sheathing prior to installation of roofing system.

B. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to ensure that completed roof will be free of leaks.

C. Coordinate installation of waterproof membrane over roof sheathing with Section 06 10 00.

D. Remove protective film from surface of roof panels immediately prior to installation; strip film carefully to avoid damage to prefinished surfaces.

E. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by metal roof panel manufacturer.

F. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

G. At locations where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

A. Overall: Install roofing system in accordance with approved shop drawings and metal roof panel manufacturer's instructions and recommendations, as applicable to specific project conditions; securely anchor components of roofing system in place allowing for thermal and structural movement.
   1. Install roofing system with concealed clips and fasteners.
   2. Minimize field cutting of panels. Where field cutting is required, use methods that will not distort panel profiles. Use of torches for field cutting is prohibited.

B. Accessories: Install necessary components that are required for complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, rib closures, and similar roof accessory items.

C. Install roofing underlayment and slip sheet on roof sheathing before installing preformed metal roof panels; secure by methods acceptable to roof panel manufacturer, minimizing use of metal fasteners; apply from eaves to ridge in shingle fashion, overlapping horizontal joints at least 2 inches (50 mm) and side and end laps at least 3 inches (75 mm); offset seams in underlayment.

D. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.
   1. Provide concealed clips at panel joints.

3.04 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.05 PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION 07 41 13

This page intentionally left blank

SECTION 07 42 13
METAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured metal panels for exterior wall panels, with related flashings and accessory components.

B. Explosion relief panels.

1.02 RELATED REQUIREMENTS

A. Section 07 21 00 - Thermal Insulation.

B. Section 07 25 00 - Weather Barriers: Weather barrier under wall panels.

C. Section 07 92 00 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.

B. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process 2022.

C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.

D. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components 2023.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.

C. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.

D. Samples: Submit two samples of wall panel, 12 inches by 12 inches (305 mm by 305 mm) in size illustrating finish color, sheen, and texture.

E. Test Reports: Submit test report verifying compliance with NFPA 285 for previously-tested exterior wall assembly.

F. Manufacturer's qualification statement.

G. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years of documented experience.

B. Installer Qualifications: Company specializing in installing products specified in this section with minimum three years of documented experience.

1.06 MOCK-UPS

A. See Section 1-06.8 for additional mock-up requirements.

B. Construct mock-up, 20 feet (6.1 m) long by 20 feet (6.1 m) wide; include panel system, attachments to building frame, associated vapor retarder and air seal materials, weep drainage system, sealants and seals, weather barrier, and related insulation in mock-up.

C. Mock-up may remain as part of work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.

C. Prevent contact with materials that may cause discoloration or staining of products.

1.08 FIELD CONDITIONS

A. Do not install wall panels when air temperature or relative humidity are outside manufacturer's limits.

1.09 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Finish Warranty: Provide 20-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Contracting Agency's name and register with warrantor.

C. Special Warranty: Provide 5-year warranty covering water tightness and integrity of seals of metal wall panels. Complete forms in Contracting Agency's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Metal Wall/Roof Panels: SpanSeam standing seam by AEP Span; https://www.aepspan.com/#sle

B. Metal Wall Panels - Concealed Fasteners:
   1. Metal Roofing Systems, Inc: www.metalroofingsystems.biz/#sle.
   2. Metl-Span, a Division of NCI Group, Inc: www.metlspan.com/#sle.
   3. AEP Span; SpanSeam: www.aepspan.com/#sle.
   4. Taylor Metal Products: https://taylormetal.com/#sle.
   5. Substitutions: See Section 1-06.7.

2.02 METAL WALL PANEL SYSTEM

A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
   1. Provide exterior wall panels.
   2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
   3. Design Pressure: In accordance with applicable codes.
   4. Maximum Allowable Deflection of Panel: L/180 for length(L) of span.
   5. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
   6. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
   7. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
   8. Corners: Factory-fabricated in one continuous piece with minimum 2-inch (51 mm) returns.
   9. Provide continuity of weather barrier seal at building enclosure elements in accordance with requirements; see Section 07 25 00.

B. Exterior Wall Panels:
   1. Profile: Standing Seam.
   2. Side Seams: Double-interlocked, tight-fitting.
   3. Material: Precoated steel sheet, 22 gauge, 0.0299 inch (0.76 mm) minimum thickness.
   4. Panel Width: 16 inches (406 mm).

5. Panel Length: Continuous full length panels.
6. Finish: Smooth
7. Color: ZincAlume® Plus.

C. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; brake formed to required angles.

D. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

E. Anchors: Galvanized steel.

2.03 EXPLOSION/PRESSURE RELIEF VENTS

A. Products:
1. Construction Specialties, Inc; Explosion and Pressure Relief Vent, Explovent - ERP-IC Top Hinged: www.c-sgroup.com/#sle.
2. Substitutions: See Section 1-06.7.

B. Vent Panel: Top-hinged, semi-rigid insulated core with 0.032 inch (0.81 mm) thick aluminum cover sheet, Grade 3003 with smooth finish laminated to both sides, and factory-assembled release mechanism.
1. Basis of Design Product and Manufacturer: Explovent ERP-IC by Construction Specialties.
2. Thickness: 2 inch (51 mm), nominal.
3. Panel Size: As indicated on drawings.
4. Panel Frame: Extruded aluminum, 0.063 inch (1.6 mm) minimum thickness, 6063-T52 alloy, with aluminum fasteners.
5. Panel Gaskets:
   a. Panel gaskets on exterior, pile fiber type with a continuous polypropylene center fin.
   b. Panel gaskets on interior, open cell compression foam clad with a polyethylene liner.
6. Finish: Clear anodized aluminum,
7. Release Assembly: Trip valve release mechanism mounted to panel frame.

2.04 MATERIALS

A. Precoated Steel Sheet: Aluminum-zinc alloy-coated steel sheet, ASTM A792/A792M, Commercial Steel (CS)) or Forming Steel (FS), with AZ50/AZM150 coating; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

B. Precoated Aluminum Sheet: ASTM B209/B209M, 3105 alloy, O temper, with smooth surface texture; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

C. Select materials with surface flatness, smoothness, and lack of surface blemishes where exposed to view in finished system.

2.05 FINISHES

A. Panel Backside Finish: Panel manufacturer's standard siliconized polyester wash coat.

B. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch (0.023 mm); color and gloss as selected by Architect from manufacturer’s standard line.

2.06 ACCESSORIES

A. Support for Cladding:
1. 6063-T5 architectural grade aluminum hat channel or zee profiles for attachment to building structure.
2. Provide appropriate hat channel or zee profile for secure cladding attachment per cladding manufacturers requirements.
3. Small vertical leg perforated minimum of 40% for drainage.
4. Clip Depth: 3/4 inch.
5. Spacing of Clips: 16 or 32 inch per cladding manufacturers requirements.

6. Fasteners: As recommended by channel and zee manufacturer for cladding load requirements and long term durability.
7. Basis of Design Manufacturer and Product: AFS Architectural Facade Systems; XKELEX X-H19PF hat channel profile pr XKELEX X-Z19PF zee profile.
8. Manufacturers:
   a. AFS Architectural Facade Systems: www.afs-na.com/#sle.
   b. Knight Wall Systems: knightwallsystems.com/#sle.
   c. Rapid Materials: rapidmaterials.com/#sle.
   d. Substitutions: See Section 1-06.7.

B. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.

C. Concealed Sealants: Non-curing butyl sealant or tape sealant, see Section 07 92 00

D. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.

E. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized.
   1. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws.

F. Field Touch-up Paint: As recommended by panel manufacturer.

G. Bituminous Paint: Asphalt base.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building framing members are ready to receive panels.

B. Verify that water-resistive barrier, see Section 07 25 00, has been installed over wall panel substrate.

3.02 PREPARATION

A. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

3.03 INSTALLATION

A. Install panels on walls in accordance with manufacturer's instructions.

B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint; allow to dry prior to wall panel installation.

C. Fasten panels to structural supports; aligned, level, and plumb.

D. Locate joints over supports.

E. Provide expansion and control joints where indicated.

F. Use concealed fasteners unless otherwise indicated by Contracting Agency.

G. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.04 TOLERANCES

A. Offset From True Alignment Between Adjacent Members Abutting or In Line: 1/16 inch (1.6 mm), maximum.

B. Variation from Plane or Location As Indicated on Drawings: 1/4 inch (6.4 mm), maximum.

3.05 CLEANING

A. Remove site cuttings from finish surfaces.

B. Remove protective material from wall panel surfaces.

C. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

3.06 PROTECTION

A. Protect metal wall panels and vents until completion of project.

B. Touch-up, repair, or replace damaged wall panels or accessories before Date of Substantial Completion.

END OF SECTION 07 42 13

This page intentionally left blank

SECTION 07 42 43
COMPOSITE WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Composite wall panel system and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 25 00 - Weather Barriers: Water-resistive barrier.

B. Section 07 62 00 - Sheet Metal Flashing and Trim.

1.03 REFERENCE STANDARDS

A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

B. ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets 2022.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide manufacturer's data sheets on each product to be used including, but not limited to, materials, dimensions, accessories, and fasteners.

C. Shop Drawings: Indicate layout, panel locations, and configuration.
   1. Indicate size, spacing, and location of support and attachment components, connections, types and locations of fasteners.
   2. Indicate necessary provisions for structural and thermal movement between wall panel system and adjacent materials.
   3. Indicate locations and sizes of penetrations through wall panel system for Contracting Agency's approval.

D. Samples: Submit two samples of each style and color panel, 12 by 12 inches (305 mm by 305 mm) in size and showing finish color, sheen, and texture.
   1. Submit 6 inch (152 mm) to 24 inch (610 mm) long samples of support framing, trim, and corners.
   2. Submit 6 by 6 inches (152 mm by 152 mm), mounted sample of each four-way joint having equal sized panels on each corner.

E. Manufacturer's Instructions: Include instructions for storage, handling, preparation, and installation of product.

F. Manufacturer's Field Reports: Submit weekly site inspection reports of site inspection conducted by manufacturer's qualified installer including photographs to verify acceptable quality of this work.

G. Test Report: Applicable model code authority evaluation report.

H. Evaluation Service Reports: Show compliance with specified requirements.

I. Manufacturer's qualification statement.

J. Installer's qualification statement.

K. Maintenance Data: Periodic inspection recommendations and maintenance procedures.

L. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Contracting Agency's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least ten years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section with minimum three years of documented experience and approved by manufacturer.

1.06 MOCK-UPS

A. See Section 1-06.8 for additional mock-up requirements.

B. Construct mock-up of each panel type, 10 feet (3.048 m) long by 10 feet (3.048 m) wide. Include panel materials, flashings, weep drainage system, attachments, anchors, trim and termination accessories, and perimeter sealant.

C. Mock-up may remain as part of work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store materials with labels intact in manufacturer's unopened packaging until ready for installation.

B. Store products under waterproof cover, well ventilated, and elevated above grade on a flat surface.

C. Protect materials from harmful environmental elements, construction dust, direct sunlight, and other potentially detrimental conditions.

1.08 FIELD CONDITIONS

A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.

1.09 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Extended Correction Period: Correct defective work within 2-year period from Date of Substantial Completion.

C. Manufacturer Warranty: Provide manufacturer limited warranty for each panel style of 15 years for panels

D. Finish Warranty: Provide manufacturer's warranty covering failure of factory-applied exterior finish and agreeing to repair or replace panels that show finish degradation including, but not limited to, peeling, blistering, wrinkling, or loss of color, pattern, or appearance within specified warranty period of 15 years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Composite Wall Panels:
   1. Swisspearl: www.swisspearl.com/#sle.
   2. Substitutions: See Section 1-06.7.

2.02 COMPOSITE WALL PANELS

A. Panels: Fiber-cement sheets in compliance with ASTM C1186, Type A.
   1. Design Wind Loads: Comply with requirements of authorities having jurisdiction.
   2. Surface Burning Characteristics: Maximum flame spread index of zero and maximum smoke developed index of five, when tested in accordance with ASTM E84.

B. Rainscreen Assembly: Ventilated cavity formed by back of panels and water-resistive barrier; provide positive drainage to exterior from moisture entering or condensation occurring within panel system.

C. Panel Style: Simulated smooth appearance.
   1. Height: ~50 inches (1250 mm).
   2. Length: ~120 inches (3030 mm).
   3. Thickness: ~5/16 inch (7.94 mm).
   4. Panel Orientation: As indicated on drawings..
   5. Surface Texture: Manufacturer's standard for product selected.
   6. Color: As indicated on drawings.
   7. Products:
      a. Swisspearl Patina.
      b. Substitutions: See Section 1-06.7.

D. Soffit Panels: Panels of same material and finish.

2.03 ACCESSORIES

A. Support for Cladding:
   1. 6063-T5 architectural grade aluminum hat channel or zee profiles for attachment to building structure.
   2. Provide appropriate hat channel or zee profile for secure cladding attachment per cladding manufacturers requirements.
   3. Small vertical leg perforated minimum of 40% for drainage.
   4. Clip Depth: 3/4 inch.
   5. Spacing of Clips: 16 or 32 inch per cladding manufacturers requirements.
   6. Fasteners: As recommended by channel and zee manufacturer for cladding load requirements and long term durability.
   7. Basis of Design Manufacturer and Product: AFS Architectural Facade Systems; XKELEX X-H19PF hat channel profile pr XKELEX X-Z19PF zee profile.
   8. Manufacturers:
      a. AFS Architectural Facade Systems: www.afs-na.com/#sle.
      b. Knight Wall Systems: knightwallsystems.com/#sle.
      c. Rapid Materials: rapidmaterials.com/#sle.
      d. Substitutions: See Section 1-06.7.

B. Trim: Same material and texture as panel.

C. Metal Trim: Extruded aluminum alloy 6063-T5 temper by panel manufacturer.
   1. Dimension and Layout: As indicated on drawings.
   2. Color: As selected by Contracting Agency.

D. Flashing: Manufacturer's standard sheet aluminum, finish and color to match wall panel above..

E. Sealant: ASTM C920, Class 35, elastomeric, polyurethane or silyl-terminated polyether/polyurethane, and capable of being painted.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrate, clean and repair as required to eliminate conditions that would be detrimental to proper installation.

B. Verify that water-resistive barrier has been properly installed; see Section 07 25 00.

C. Inspect products thoroughly prior to installation. Do not install any product which may have been damaged in shipment or appears to have a damaged or irregular finish.

D. Do not begin until unacceptable conditions have been corrected.

E. If substrate preparation is responsibility of another installer, notify Contracting Agency of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Touch-up field cut edges before installing.

B. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

3.03 INSTALLATION

A. Sheet Metal Flashing: Install in accordance with wall panel manufacturer's instructions and as indicated on drawings.

B. Wall Panels:
   1. Install in accordance with manufacturer's instructions.
   2. Install wall panels with manufacturer's recommended exposed attachment system.
   3. Do not install wall panels less than 6 inches (150 mm) above surface of ground, nor closer than 1 inch (25 mm) to surfaces where water may collect.
   4. Allow space for thermal movement at ends of wall panels that butt against trim; seal joint between panel and trim.

C. Install control and expansion joints as detailed on drawings.
   1. Vertical Joints: Install at locations and with spacings recommended by wall panel manufacturer.
   2. Horizontal/Compression Joints: Install at locations and with spacings recommended by wall panel manufacturer.

D. After installation, seal joints including, but not limited to, around penetrations, and between wall panels and adjacent construction.

E. Paint exposed cut edges.

3.04 CLEANING

A. Clean exposed work upon completion of installation; remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to finish.

3.05 PROTECTION

A. Protect installed products until Date of Substantial Completion.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 07 42 43

SECTION 07 53 23
EPDM THERMOSET SINGLE-PLY ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Adhered roof system with ethylene propylene diene monomer (EPDM) roofing membrane.

B. Insulation, flat and tapered.

C. Vapor retarder.

D. Deck sheathing.

E. Roofing cant strips, stack boots, roofing expansion joints, and walkway pads.

1.02 RELATED REQUIREMENTS

A. Section 05 31 00 - Steel Decking.

B. Section 07 62 00 - Sheet Metal Flashing and Trim: Counterflashing and reglets.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2017.

C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board 2022a.

D. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane 2015, with Editorial Revision (2022).

E. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces 2011 (Reapproved 2019).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.
   1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.05 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide manufacturer's written information listed below.
   1. Product data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements.

C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.

D. Samples for Selection: Submit two samples 6 by 6 inches (152.4 by 152.4 mm) in size illustrating insulation, coating, and fleece backing.

E. Samples for Verification: Submit two samples 6 by 6 inches (152.4 by 152.4 mm) in size illustrating insulation, coating, and fleece backing.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

G. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and other supplementary instructions.

H. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.

I. Specimen Warranty: For approval.

J. Warranty:

1. Submit manufacturer warranty and ensure that forms have been completed in Contracting Agency's name and registered with manufacturer.
2. Submit installer's certification that installation complies with all warranty conditions for the waterproof membrane.

K. Manufacturer's Qualification Statement.

L. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty (20) years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this section:
1. With minimum five years documented experience.
2. Approved by membrane manufacturer.

1.07 MOCK-UPS

A. See Section 1-06.8 for additional mock-up requirements.

B. Provide mock-up for evaluation of surface preparation, installation methods, and workmanship.

C. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.

B. Protect products in weather protected environment, clear of ground and moisture.

C. Protect foam insulation from direct exposure to sunlight.

D. Keep Safety Data Sheets (SDS) at the project site at all times during transportation, storage, and installation of materials.

E. Comply with requirements from Contracting Agency and manufacturer to prevent overloading or disturbance of the structure when loading materials onto the roof.

1.09 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather. Refer to manufacturer's written instructions.

B. Do not apply roofing membrane when ambient temperature is below 40 degrees F (5 degrees C) or above 80 degrees F (27 degrees C).

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

E. Proceed with work so new roofing materials are not subject to construction traffic as work progresses.

F. Do not allow grease, oil, fats, or other contaminants to come into direct contact with membrane.

1.10 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Material Warranty: Provide membrane manufacturer's warranty agreeing to replace material that shows manufacturing defects within 10 years after installation.

C. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
1. Warranty Term: 25 years.
2. For repair and replacement include costs of both material and labor in warranty.
3. Include damage caused by 1 inch (25 mm) maximum diameter hail.
4. Exceptions NOT Permitted:
   a. Damage due to roof traffic.

b. Damage due to wind of speed greater than 56 mph (90 km/h) but less than 90 mph (145 km/h).

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carlisle SynTec Systems: www.carlisle-syntec.com/#sle.

B. Substitutions: See Section 1-06.7.

2.02 ROOFING APPLICATIONS

A. EPDM Membrane Roofing: Lower roofs, one ply membrane, fully adhered, over vapor retarder and insulation and upper roofs, one ply membrane, fully adhered over vapor retarder and insulation.

B. Roofing Assembly Performance Requirements and Design Criteria:
   1. Solar Reflectance Index (SRI): 78, minimum, calculated in accordance with ASTM E1980.
      a. Field applied coating may not be used to achieve specified SRI.
   2. Wind Uplift:
      a. Designed to withstand wind uplift forces calculated with ASCE 7.
      b. Design Wind Speed: In accordance with local building code and authorities having jurisdiction (AHJ).
   3. Insulation Thermal Resistance (R-Value): Provide R-Value over entire roof deck in accordance with local building code requirements.
   4. Drainage: No standing water within 48 hours after precipitation.

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Single Source Responsibility: Provide and install products from single source.

B. Membrane:
   1. Material: Ethylene propylene diene monomer (EPDM); ASTM D4637/D4637M, Type I (non-reinforced).
   2. Thickness: 60 mil, 0.060 inch (1.5 mm), minimum.
   3. Sheet Width: Factory fabricated into largest sheets possible.
   4. Color: White on Black.
   5. Products:
      a. Carlisle SynTec Systems; Sure-White.

C. Seaming Materials: As recommended by membrane manufacturer.

D. Membrane Fasteners: As recommended and approved by membrane manufacturer.

E. Vapor Retarder: Material approved by roof manufacturer complying with requirements of fire rating classification; compatible with roofing and insulation materials.
   1. Fire-retardant adhesive.

F. Flexible Flashing Material: Same material as membrane.

G. Base Flashing: Provide waterproof, fully adhered base flashing system at all penetrations, plane transitions, and terminations.

2.04 DECK SHEATHING AND COVER BOARDS

A. Deck Sheathing and Cover Board: Glass mat faced gypsum panels, ASTM C1177/C1177M, fire resistant type, 1/4 inch (6 mm) thick.
   1. Product:
      a. GP Dens-Deck, distributed by Carlisle SynTec Systems.

2.05 INSULATION

A. Polyisocyanurate (ISO) Board Insulation: ASTM C1289, Type II, Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of the core foam; Grade 1.
   1. Compressive Strength: 25 psi (172 kPa).
   2. Product:
      a. Carlisle InsulBase.

2.06 ACCESSORIES

A. Prefabricated Flashing Accessories:
   1. Corners and Seams: Same material as membrane, in manufacturer's standard thicknesses.
      a. Carlisle SynTec Systems; Sure-White (white) Pressure-Sensitive Inside/Outside Corner: 60 mil, 0.060 inch (1.5 mm) thick, 7 by 9 inches (178 by 229 mm) precut, uncured EPDM with 35 mil, 0.035 inch (0.9 mm) factory-applied tape.
      b. Carlisle SynTec Systems; Sure-White Pressure-Sensitive Curb Flashing: 60 mil, 0.060 inch (1.5 mm) thick, 20 inches (508 mm) wide, cured EPDM with 35 mil, 0.035 inch (0.9 mm) thick, 5 inches (127 mm) wide factory-applied tape along one edge.
      c. Carlisle SynTec Systems; Sure-White Pressure-Sensitive Cured Cover Strip: 40 mil, 0.040 inch (1.0 mm) thick, cured EPDM laminated to 35 mil, 0.035 inch (0.9 mm) factory-applied tape.
      d. Carlisle SynTec Systems; Sure-White Pressure-Sensitive T-Joint Covers: 40 mil, 0.040 inch (1.0 mm) thick, uncured EPDM laminated to 35 mil, 0.035 inch (0.9 mm) factory-applied tape.
      e. Carlisle; Sure-White Elastoform Flashing: 60 mil, 0.060 inch (1.5 mm) thick, uncured EPDM membrane.
      f. Carlisle SynTec Systems; Sure-White Pressure-Sensitive Elastoform Flashing: 60 mil, 0.060 inch (1.5 mm) thick, uncured EPDM laminated to 35 mil, 0.035 inch (0.9 mm) factory-applied tape.
   2. Penetrations: Same material as membrane, with manufacturer's standard cut-outs, rigid inserts, clamping rings, and flanges.
      a. Carlisle SynTec Systems; Sure-White Pressure-Sensitive Pipe Seals; with factory-applied tape on deck flange.
   3. Sealant Pockets: Same material as membrane, with manufacturer's standard accessories, in manufacturer's standard configuration.
      a. Carlisle SynTec Systems; Sure-White Pourable Sealant Pocket: 2 inches (51 mm) wide plastic support strip with factory-applied, adhesive-backed uncured EPDM flashing.
   4. Carlisle SynTec Systems; Sure-Seal Pressure-Sensitive Reinforced Universal Securement Strip (RUSS):
      a. 9 inches (229 mm) wide, 45 mil, 0.045 inch (1.1 mm) thick, reinforced EPDM membrane with 3 inches (76 mm) wide, 30 mil, 0.030 inch (0.76 mm) thick cured synthetic rubber with pressure-sensitive adhesive laminated to both edges.
   5. Sure-White Pressure-Sensitive Reinforced Universal Securement Strip (RUSS): 6 inches (152 mm) wide, 45 mil, 0.045 inch (1.1 mm) thick, reinforced EPDM membrane with 3 inches (76 mm) wide, 30 mil, 0.030 inch (0.76 mm) thick cured synthetic rubber with pressure-sensitive adhesive laminated to one edge.

B. Insulation Adhesive: Two component polyurethane, expanding foam.

C. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches (152 mm) wide; self-adhering.

D. Membrane Adhesive: As recommended by membrane manufacturer.

E. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

F. Sealants: As recommended by membrane manufacturer.

G. Cleaner: Manufacturer's standard, clear, solvent-based cleaner.

H. Primer: Manufacturer's recommended product.

I. Edgings and Terminations: Manufacturer's standard edge and termination accessories.
   1. Products: Snap-on edge system.
   2. Products: Anchor bar fascia system.
   3. Products: Coping.
   4. Termination Bar.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 PREPARATION, GENERAL

A. Clean substrate thoroughly prior to roof application.

B. Do not begin work until other work that requires foot or equipment traffic on roof is complete.

C. Apply manufacturer's recommended vapor retarder or temporary roof before roof installation.

3.03 METAL DECK PREPARATION

A. Install deck sheathing on metal deck:
   1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
   2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
   3. Tape joints.

B. Fasten sheathing to roof deck with continuous mopping of adhesive on each flute.

3.04 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

F. Coordinate the work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

G. When substrate preparation is responsibility of another installer, notify Contracting Agency of unsatisfactory conditions before proceeding.

3.05 VAPOR RETARDER INSTALLATION

A. Apply vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
   1. Extend vapor retarder under cant strips and blocking to deck edge.
   2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.

B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.

3.06 VAPOR RETARDER AND INSULATION APPLICATION

A. Attachment of Insulation: Embed insulation in adhesive in full contact, in accordance with roofing and insulation manufacturer's instructions.

B. Do not install wet, damaged, or warped insulation boards.

C. Lay subsequent layers of insulation with joints staggered minimum 6 inches (152 mm) from joints of preceding layer.

D. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

E. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.

F. Lay boards with edges in moderate contact without forcing, and gap between boards no greater than 1/4 inch (6.4 mm). Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

G. Tape joints of insulation in accordance with roofing and insulation manufacturers instructions.

H. At roof drains, use factory-tapered boards to slope down to roof drains over 18 inches (457 mm).

I. Do not apply more insulation than can be completely waterproofed in the same day.

3.07 MEMBRANE APPLICATION

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Fully Adhered Application: Apply adhesive at manufacturer's recommended rate. Fully embed membrane in adhesive except in areas directly over or within 3 inches (76 mm) of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.

D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches (76 mm). Seal permanently waterproof.

E. At intersections with vertical surfaces:
   1. Extend membrane over cant strips and up a minimum of 4 inches (102 mm) onto vertical surfaces.
   2. Fully adhere flexible flashing over membrane and up to nailing strips.
   3. Secure flashing to nailing strips at 4 inches (102 mm) on center.
   4. Insert flashing into reglets and secure.

F. At gravel stops, extend membrane under gravel stop and to the outside face of the wall.

G. Install roofing expansion joints where indicated, and ensure joints are watertight.

H. Install prefabricated joint components in accordance with manufacturer's instructions.

I. Coordinate installation of roof drains and sumps and related flashings, locate field splices away from low areas and roof drains, and lap upslope sheet over downslope sheet.

J. Install walkway pads at areas of concentrated traffic as indicated on drawings, and space pad joints to permit drainage.

K. Daily Seal: Install daily seal per manufacturer's instructions at the end of each workday. Prevent infiltration of water at incomplete flashings, terminations, and at unfinished membrane edges.

3.08 FIELD QUALITY CONTROL

A. Require site attendance of roofing and insulation material manufacturers daily during installation of this work.

3.09 CLEANING

A. Remove wrappings, empty containers, paper, and other debris from the roof daily. Dispose of debris in compliance with local, State, and Federal regulations.

B. Remove bituminous markings from finished surfaces.

C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

D. Repair or replace defaced or damaged finishes caused by work of this section.

3.10 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION 07 53 23

This page intentionally left blank

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, and exterior penetrations.

B. Sealants for joints within sheet metal fabrications.

C. Sheet metal splash pans.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

C. ASTM B32 - Standard Specification for Solder Metal 2020.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

E. ASTM D2178/D2178M - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing 2015a (Reapproved 2021).

F. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free 2007 (Reapproved 2018).

G. CDA A4050 - Copper in Architecture - Handbook current edition.

H. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

C. Samples: Submit two samples 6 by 6 inch (153 by 153 mm) in size illustrating metal finish color.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

B. Maintain one copy of each document on site.

C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sheet Metal Flashing and Trim:
   1. Fairview Architectural LLC: www.fairview-na.com/#sle.
   2. Petersen Aluminum Corporation: www.pac-clad.com/#sle.
   3. Tamlyn: www.tamlyn.com/#sle.

4. Substitutions: See Section 1-06.7.

B. Exterior Penetration Flashing Panel:
   1. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
   2. Substitutions: See Section 1-06.7.

2.02 SHEET MATERIALS

A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch (0.61 mm) thick base metal.

B. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch (0.61 mm) thick base metal, shop pre-coated with PVDF coating.
   1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: As selected by Contracting Agency from manufacturer's full colors.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18-inch (450 mm) long legs; seam for rigidity, seal with sealant.

F. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.

G. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing. Return and brake edges.

2.04 GUTTERS AND DOWNSPOUTS

A. Gutters: SMACNA (ASMM) Rectangular profile.

B. Downspouts: Rectangular profile.

C. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM).

D. Accessories: Profiled to suit gutters and downspouts.
   1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
   2. Gutter Supports: Brackets.
   3. Downspout Supports: Brackets.

E. Splash Pans: Same metal type as downspouts.

F. Downspout Boots: Steel.

G. Downspout Extenders: Same material and finish as downspouts.

H. Seal metal joints.

2.05 EXTERIOR PENETRATION FLASHING PANELS

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.06 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Underlayment: ASTM D2178/D2178M, glass fiber roofing felt.

C. Slip Sheet: Rosin-sized sheathing paper.

D. Primer Type: Zinc chromate.

E. Concealed Sealants: Non-curing butyl sealant.

F. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

G. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

H. Reglets: Surface-mounted type, galvanized steel; face and ends covered with plastic tape.

I. Solder: ASTM B32, Alloy Grade - Sn50 (50/50).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.

C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.38 mm).

3.03 INSTALLATION

A. Comply with drawing details.

B. Insert flashings into reglets to form tight fit; secure in place with lead wedges; pack remaining spaces with lead wool; seal flashings into reglets with sealant.

C. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

D. Apply plastic cement compound between metal flashings and felt flashings.

E. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

F. Exterior Flashing Receivers: Install in accordance with manufacturer's recommendations, and in proper relationship with adjacent construction, and as follows:
   1. Secure receiver at perimeter of wall opening with adhesives or fasteners.
   2. Place flashing into receiver channel.
   3. Secure flashing with receiver clip.

G. Seal metal joints watertight.

H. Secure gutters and downspouts in place with concealed fasteners.

I. Slope gutters 1/4 inch per 10 feet (2.1 mm per m), minimum.

J. Connect downspouts to downspout boots, and grout connection watertight.

K. Set splash pans under downspouts.

3.04 FIELD QUALITY CONTROL

A. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION 07 62 00

This page intentionally left blank

SECTION 07 72 00
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof curbs.

B. Roof hatches with guardrails.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. 29 CFR 1910.23 - Ladders Current Edition.

B. 29 CFR 1910.29 - Fall Protection Systems and Falling Object Protection - Criteria and Practices Current Edition.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.

E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.

C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.

D. Warranty Documentation:
   1. Submit manufacturer warranty.
   2. Ensure that forms have been completed in Contracting Agency's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

1.06 WARRANTY

A. Manufacturer Warranty: Provide 2-year manufacturer warranty for roof hatches. Complete forms in Contracting Agency's name and register with manufacturer.

PART 2 PRODUCTS

2.01 ROOF CURBS

A. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
   1. Applications: Roof curbs used for roof penetrations/openings as indicated on drawings.
   2. Roof Curb Mounting Substrate: Curb substrate consists of flat roof deck sheathing with insulation and existing sloped roof deck sheathing with insulation.
   3. Sheet Metal Material:
      a. Galvanized Steel: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33 (230); G60 (Z180) coating designation; 18 gauge, 0.048

inch (1.21 mm) thick.
1) Finish: Factory primed.

4. Provide layouts and configurations indicated on drawings.

B. Curbs Adjacent to Roof Openings: Provide curb on each side of opening, with top of curb horizontal for equipment mounting.
1. Insulate inside curbs with 1-1/2 inch (38 mm) thick fiberglass insulation.
2. Height Above Finished Roof Surface: 8 inches (203 mm), minimum.

C. Equipment Support: Straight curbs on each side of equipment, with top of curbs parallel with metal roofing system and each other for equipment mounting.
1. Height Above Metal Roofing System: 5 inches (127 mm), minimum.

2.02 ROOF HATCHES AND VENTS

A. Basis of Design Manufacturer and Product: Bilco Company: Type E (ladder access, 3 ft square, solid cover); www.bilco.com/#sle.

B. Roof Hatch Manufacturers:
1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com/#sle.
2. Acudor Products Inc: www.acudor.com/#sle.
3. Bilco Company: www.bilco.com/#sle.
4. Nystrom, Inc: www.nystrom.com/#sle.

C. Roof Hatches and Smoke Vents: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
1. Style: Provide flat metal covers unless otherwise indicated.
2. Mounting: Provide frames and curbs suitable for mounting conditions as indicated on drawings.
3. Thermally Broken Hatches: Provide insulation within frame and cover.
4. Size: As indicated on drawings; single-leaf style unless otherwise indicated.
5. For Ladder Access: Single leaf; 36 by 36 inches (914 by 914 mm).

D. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
1. Material: Mill finished aluminum, 11 gauge, 0.0907 inch (2.3 mm) thick.
2. Insulation: Manufacturer's standard; 1 inch (25 mm) rigid.
3. Curb Height: 12 inches (305 mm) from finished surface of roof, minimum.

E. Metal Covers: Flush, insulated, hollow metal construction.
1. Capable of supporting 40 psf (1.92 kPa) live load.
2. Material: Mill finished aluminum; outer cover 11 gauge, 0.0907 inch (2.3 mm) thick, liner 0.04 inch (1.0 mm) thick.
3. Insulation: Manufacturer's standard 3 inch (76 mm) rigid glass fiber.
4. Gasket: EPDM, continuous around cover perimeter.

F. Safety Railing System: Roof hatch safety rail system mounted directly to curb without penetration of roofing system.
1. Railing Size: 36 by 36 inches (914 by 914 mm).
2. Railing: Comply with 29 CFR 1910.23 for ladder safety, with a safety factor of two.
3. Self-Closing Gate: Comply with 29 CFR 1910.29 for safe egress and fall protection through hatch opening.
4. Posts and Rails: Aluminum tubing.
5. Gate: Same material as railing; automatic closing with latch.
6. Finish: Manufacturer's standard, factory applied finish.
7. Gate Hinges and Post Guides: ASTM B221 (ASTM B221M), 6063 alloy, T5 temper aluminum.
8. Mounting Brackets: Hot dipped galvanized steel, 1/4 inch (6.4 mm) thick, minimum.
9. Fasteners: Stainless steel, Type 316.
10. Products:
a. Activar Construction Products Group, Inc. - JL Industries; RTA Safety Railing, Model SHWC with gate and grab bar: www.activarcpg.com/#sle.

b. BILCO Company; Bil-Guard 2.0: www.bilco.com/#sle.
c. Safety Rail Company; Roof HatchGuard, Non-Penetrating Fall Protection: www.safetyrailcompany.com/#sle.

G. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf (475 kPa) load.
2. Hinges: Heavy duty pintle type.
3. Hold open arm with vinyl-coated handle for manual release.
4. Latch: Upon closing, engage latch automatically and reset manual release.
5. Manual Release: Pull handle on interior.
6. Locking: Padlock hasp on interior.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Contracting Agency of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 CLEANING

A. Clean installed work to like-new condition.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 07 72 00

This page intentionally left blank

SECTION 07 81 23
INTUMESCENT FIRE PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Thin-film intumescent fire protection.

1.02 RELATED REQUIREMENTS

A. Section 09 90 00 - Painting and Coating: Field-applied paints matching intumescent fireproofing.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.

B. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015 (Reapproved 2021).

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.

D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2022.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Performance characteristics and test results.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.

C. Selection Samples: For decorative top coat, color chips representing manufacturer's full range of available colors and sheens.

D. Verification Samples: For each thickness, color, sheen, and finish required, submit samples not less than 4 inches (102 mm) square on designated substrate illustrating finished appearance.

E. Certificates: Certify that intumescent fireproofing provided for this project meets or exceeds specified requirements in all respects.

F. Test Reports: Published fire resistive designs for structural elements of the types required for the project, indicating hourly ratings of each assembly.

G. Manufacturer's qualification statement.

H. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company that specializes in manufacturing the type of products specified, with minimum of ten years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.06 MOCK-UPS

A. See Section 1-06.8 for additional mock-up requirements.

B. Provide a mock-up for evaluation of surface preparation techniques and application workmanship; approved mock-up will serve as a standard of comparison for subsequent work of this section.

C. Finish at least 100 sq ft (10 sq m) of surface in areas as designated by Contracting Agency.

D. Evaluate mock-up for compliance with specified requirements, including thickness and finish texture.

E. Do not proceed with remaining work until workmanship, color, and sheen are approved by Contracting Agency.

F. Refinish mock-up area as required to produce acceptable work.

G. Approved mock-up may remain as part of the project.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened containers with identification labels and testing agency markings intact and legible.

B. Store products in manufacturer's unopened packaging until ready for installation.
   1. Store at temperatures not less than 50 degrees F (10 degrees C) in dry, protected area.
   2. Protect from freezing, and do not store in direct sunlight.
   3. Dispose of any materials that have come into contact with contaminants of any kind prior to application.

C. Dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.08 FIELD CONDITIONS

A. Protect areas of application from windblown dust and rain.

B. Maintain ambient field conditions, such as temperature, humidity, and ventilation, within limits recommended by manufacturer for optimum results. Do not install products under ambient conditions outside manufacturer's absolute limits.
   1. Provide temporary enclosures as required to control ambient conditions.
   2. Do not apply intumescent fireproofing when ambient temperatures are below 50 degrees F (10 degrees C) without specific approval from manufacturer.
   3. Ensure that relative humidity is between 40 and 60 percent in areas of application.
   4. Provide ventilation in enclosed spaces during application and for not less than 72 hours afterward.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Intumescent Thin-Film Fire Protection for Metal:
   1. Contego International, Inc; Contego RUSTEX 710 Metal Primer HS Low VOC: www.contegointernational.com/#sle.
   2. FlameOFF Coatings, Inc; FlameOFF Fire Barrier Paint: www.flameoffcoatings.com/#sle.
   3. Hilti, Inc; Fire Finish Steel Protection Spray CFP-SP WB: www.hilti.com/#sle.
   4. Hilti, Inc; All Weather High Build CFP-SP AWHB: www.hilti.com/#sle.
   5. International Coatings Group; FBL-200 Fire Barrier Latex: www.internationalcoatingsgroup.com/#sle.
   6. Quantum Chemical; SafeCoat Steel: www.quantumchemical.com/#sle.
   7. Shield Industries, Inc; FireGuard E-84 Intumescent Coating: www.shieldindustries.com/#sle.
   8. Substitutions: See Section 1-06.7.

2.02 SYSTEM REQUIREMENTS

A. Fireproofing: Provide intumescent thin-film fire protection systems tested by an independent testing agency in accordance with ASTM E119 and acceptable to authorities having jurisdiction (AHJ).
   1. Provide assemblies listed by UL or FM and bearing listing agency label or mark.

B. Structural Steel Columns: Fire resistance rating of as noted on Drawings.

C. Structural Steel Beams and Exposed Steel Deck: Fire resistance rating as noted on Drawings.

2.03 MATERIALS

A. Fire Resistive Coating System: Thin-film intumescent fire protection system for structural steel.
   1. Surface Burning Characteristics: Class A, flame spread/smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.

2. For Interior Use:
    a. Use only water-based products.
    b. Use only products without fiber content.
    c. VOC Content: Less than 500 g per L when tested in accordance with 40 CFR 59, Subpart D (EPA Method 24).
    d. Durometer Hardness, Type D: 65, minimum, in accordance with ASTM D2240.
    e. Basis of Design: Hilti, Inc; Fire Finish Steel Protection Spray CFP-SP WB: www.hilti.com/#sle.
    f. Substitutions: See Section 1-06.7.
3. For Exterior Use:
    a. Use only water-based products.
    b. Use only products without fiber content.
    c. VOC Content: Less than 500 g per L when tested in accordance with 40 CFR 59, Subpart D (EPA Method 24).
    d. Durometer Hardness, Type D: 65, minimum, in accordance with ASTM D2240.

B. Sealers and Primer: As required by tested and listed assemblies, and recommended by fireproofing manufacturer to suit specific substrate conditions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates to determine if they are in satisfactory condition to receive intumescent fire protection; verify that substrates are clean and free of oil, grease, incompatible primers, or other foreign substances capable of impairing bond to fireproofing system.

B. Do not begin installation until substrates have been properly prepared.

C. If substrate preparation is responsibility of another installer, notify Contracting Agency of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Thoroughly clean surfaces to receive fireproofing.

B. Repair substrates to remove surface imperfections that could effect uniformity of texture and thickness of fireproofing system, and remove minor projections and fill voids that could telegraph through finished work.

C. Cover or otherwise protect other work that might be damaged by fallout or overspray of fireproofing system, and provide temporary enclosures as necessary to confine operations and maintain required ambient field conditions.

3.03 APPLICATION

A. Comply with manufacturer's instructions for each particular intumescent fire protection system installation application as indicated.

B. Apply manufacturer’s recommended primer to required coating thickness.

C. Apply fireproofing to full thickness over entire area of each substrate to be protected.

D. Apply coats at manufacturer’s recommended rate to achieve dry film thickness (DFT) as required for fire resistance ratings designated for each condition.

E. Apply intumescent fire protection by spraying to maximum extent possible, and as necessary complete coverage by roller application or other method acceptable to manufacturer.

F. Achieve uniform finished appearance complying with approved mock-up.

3.04 CLEANING

A. Immediately after installation of fireproofing in each area, remove overspray and fallout from other surfaces and clean soiled areas.

3.05 PROTECTION

A. Protect installed intumescent fire protection from damage due to subsequent construction activities, so fireproofing is without damage or deterioration before Date of Substantial Completion.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 07 81 23

SECTION 07 84 00
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

A. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2022.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).

C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems 2015 (Reapproved 2019).

D. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems 2020a.

E. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers 2020a.

F. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus 2020.

G. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies 2013 (Reapproved 2017).

H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).

I. ITS (DIR) - Directory of Listed Products Current Edition.

J. FM 4991 - Approval Standard of Firestop Contractors 2013.

K. FM (AG) - FM Approval Guide Current Edition.

L. SCAQMD 1168 - Adhesive and Sealant Applications 1989, with Amendment (2022).

M. UL 1479 - Standard for Fire Tests of Penetration Firestops Current Edition, Including All Revisions.

N. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems Current Edition, Including All Revisions.

O. UL (FRD) - Fire Resistance Directory Current Edition.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

C. Product Data: Provide data on product characteristics, performance ratings, and limitations.

D. Sustainable Design Submittal: Submit VOC content documentation for nonpreformed materials.

E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

G. Manufacturer's qualification statement.

H. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
   1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
   2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
   3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and:
   1. Trained by manufacturer.
   2. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
   3. Verification of minimum three years documented experience installing work of this type.
   4. Verification of at least five satisfactorily completed projects of comparable size and type.
   5. Licensed by local authorities having jurisdiction (AHJ).

1.06 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Firestopping Manufacturers:
   1. 3M Fire Protection Products: www.3m.com/firestop/#sle.
   2. A/D Fire Protection Systems Inc: www.adfire.com/#sle.
   3. Hilti, Inc: www.us.hilti.com/#sle.
   4. Specified Technologies Inc: www.stifirestop.com/#sle.
   5. Substitutions: See Section 1-06.7.

2.02 MATERIALS

A. Firestopping Materials: Any materials meeting requirements.

B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.

C. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.

D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

E. Performance Requirements: Fire Stopping shall be flexible, moisture resistant, and it shall not dissolve, re-emulsify, leach, break-down, deteriorate, shrink, or pull away from contact surfaces.

F. Fire Ratings: Refer to drawings for required systems and ratings.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.

B. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.

C. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.

D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

2.04 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.

1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by Contracting Agency's Independent Testing Agency.

C. Do not cover installed firestopping until inspected by authorities having jurisdiction.

D. Install labeling required by code.

3.04 FIELD QUALITY CONTROL

A. Independent Testing Agency: Inspection agency employed and paid by Contracting Agency, will examine penetration firestopping in accordance with ASTM E2174 and ASTM E2393.

B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.06 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 07 84 00

This page intentionally left blank

SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

A. Section 09 21 16 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.03 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer 2015 (Reapproved 2022).

B. ASTM C834 - Standard Specification for Latex Sealants 2017 (Reapproved 2023).

C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications 2022.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

E. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.

F. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2022.

G. ASTM C1311 - Standard Specification for Solvent Release Sealants 2022.

H. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants 2018.

I. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015 (Reapproved 2021).

J. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2016 (Reapproved 2021).

K. SCAQMD 1168 - Adhesive and Sealant Applications 1989, with Amendment (2022).

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Substrates for which use of primer is required.
   6. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
   7. Sample product warranty.
   8. Certification by manufacturer indicating that product complies with specification requirements.

C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

E. Samples for Verification: Where custom sealant color is specified, obtain directions from Contracting Agency and submit at least two physical samples for verification of color of each

required sealant.

F. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

G. Installer's qualification statement.

H. Executed warranty.

1.05 QUALITY ASSURANCE

A. Maintain one copy of each referenced document covering installation requirements on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

1.06 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Contracting Agency's name and register with manufacturer.

C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nonsag Sealants:
   1. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
   2. Pecora Corporation: www.pecora.com/#sle.
   3. Sika Corporation: www.usa-sika.com/#sle.
   4. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
   5. Substitutions: See Section 1-06.7.

B. Self-Leveling Sealants:
   1. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
   2. Pecora Corporation: www.pecora.com/#sle.
   3. Sika Corporation: www.usa-sika.com/#sle.
   4. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
   5. Substitutions: See Section 1-06.7.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to:
      a. Wall expansion and control joints.
      b. Joints between door, window, and other frames and adjacent construction.
      c. Joints between different exposed materials.
      d. Openings below ledge angles in masonry.
      e. Other joints indicated below.
   2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
      a. Joints between door, window, and other frames and adjacent construction.
      b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
      c. Other joints indicated below.
   3. Do not seal the following types of joints:

a. Intentional weep holes in masonry.
b. Joints indicated to be treated with manufactured expansion joint cover, or some other type of sealing device.
c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
d. Joints where installation of sealant is specified in another section.
e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.
2. Lap Joints between Manufactured Metal Panels: Butyl rubber, non-curing.
3. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.
4. Wiring Slots in Concrete Paving: Self-leveling epoxy sealant.

C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
2. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion.
3. Floor Joints in Wet Areas: Non-sag polyurethane "non-traffic-grade" sealant suitable for continuous liquid immersion.
4. Wall, Ceiling, and Floor Joints Where Tamper-Resistance is Required: Non-sag tamper-resistant silyl-terminated polyurethane sealant.
5. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
6. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
7. Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant.
8. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.

D. Interior Wet Areas: Bathrooms, restrooms, and kitchens; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

E. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.

F. Areas Where Tamper-Resistance is Required: As indicated on drawings.

2.03 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

2.04 NONSAG JOINT SEALANTS

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus 100 percent and minus 50 percent, minimum.
2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
4. Hardness Range: 15-20, Shore A, when tested in accordance with ASTM C661.
5. Color: Match adjacent finished surfaces.
6. Service Temperature Range: Minus 20 to 180 degrees F (Minus 29 to 82 degrees C).
7. Products:
a. Dow; DOWSIL 756 SMS Building Sealant: www.dow.com/#sle.
b. Dow; DOWSIL 790 Silicone Building Sealant: www.dow.com/#sle.
c. Dow; DOWSIL 791 Silicone Weatherproofing Sealant: www.dow.com/#sle.
d. Dow; DOWSIL 795 Silicone Building Sealant: www.dow.com/#sle.
e. Pecora Corporation; Pecora 890 NST (Non-Staining Technology): www.pecora.com/#sle.
f. Sika Corporation; Sikasil WS-290: www.usa.sika.com/#sle.
g. Sika Corporation; Sikasil WS-295: www.usa.sika.com/#sle.

h. Sika Corporation; Sikasil 728NS: www.usa.sika.com/#sle.
i. Tremco Commercial Sealants & Waterproofing; Spectrem 1: www.tremcosealants.com/#sle.
j. Substitutions: See Section 1-06.7.

B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Color: White.
2. Products:
a. Pecora Corporation; Pecora 898 NST (Non-Staining Technology): www.pecora.com/#sle.
b. Sika Corporation; Sikasil GP: www.usa.sika.com/#sle.
c. Substitutions: See Section 1-06.7.

C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Color: Match adjacent finished surfaces.
2. Service Temperature Range: Minus 40 to 180 degrees F (Minus 40 to 82 degrees C).
3. Products:
a. Pecora Corporation; DynaTrol II: www.pecora.com/#sle.
b. Pecora Corporation; DynaFlex: www.pecora.com/#sle.
c. Sika Corporation; Sikaflex-1a: www.usa.sika.com/#sle.
d. Sika Corporation; Sikaflex-15 LM: www.usa.sika.com/#sle.
e. Sika Corporation; Sikaflex-2c NS: www.usa.sika.com/#sle.
f. Tremco Commercial Sealants & Waterproofing; Dymonic 100: www.tremcosealants.com/#sle.
g. Tremco Commercial Sealants & Waterproofing; Dymeric 240 FC: www.tremcosealants.com/#sle.
h. Tremco Commercial Sealants & Waterproofing; Vulkem 116: www.tremcosealants.com/#sle.
i. Substitutions: See Section 1-06.7.

D. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
1. Color: Standard colors matching finished surfaces, Type OP (opaque).
2. Grade: ASTM C834; Grade 0 Degrees F (Minus 18 Degrees C).
3. Products:
a. Pecora Corporation; AC-20 +Silicone: www.pecora.com/#sle.
b. Tremco Commercial Sealants & Waterproofing; Tremstop Smoke and Sound: www.tremcosealants.com/#sle.
c. Substitutions: See Section 1-06.7.

E. Non-Curing Butyl Sealant: Solvent-based, single component, non-sag, non-skinning, non-hardening, non-bleeding; non-vapor-permeable; intended for fully concealed applications.

2.05 SELF-LEVELING JOINT SEALANTS

A. Self-Leveling Silicone Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
2. Hardness Range: 0 to 15, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Contracting Agency from manufacturer's standard range.
4. Service Temperature Range: Minus 40 to 180 degrees F (Minus 40 to 82 degrees C).
5. Products:
a. Dow; DOWSIL SL Parking Structure Sealant: www.dow.com/#sle.
b. Dow; DOWSIL FC Parking Structure Sealant: www.dow.com/#sle.
c. Pecora Corporation; Pecora 300 SL (Self-Leveling): www.pecora.com/#sle.
d. Sika Corporation; Sikasil 728RCS: www.usa.sika.com/#sle.

e. Tremco Commercial Sealants & Waterproofing; Spectrem 900SL: www.tremcosealants.com/#sle.
f. Substitutions: See Section 1-06.7.

B. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Contracting Agency from manufacturer's standard range.
4. Service Temperature Range: Minus 40 to 180 degrees F (Minus 40 to 82 degrees C).
5. Products:
a. Sika Corporation; Sikaflex-1c SL: www.usa.sika.com/#sle.
b. Sika Corporation; Sikaflex-2c SL: www.usa.sika.com/#sle.
c. Substitutions: See Section 1-06.7.

C. Self-Leveling Polyurethane Sealant for Horizontal Expansion Joints: ASTM C920, Grade P, Uses T, M, and O; multi-component; explicitly approved by manufacturer for horizontal expansion joints.
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Hardness Range: 30 to 35, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Contracting Agency from manufacturer's standard range.
4. Tensile Strength: 200 to 250 psi (1.38 to 1.72 MPa) in accordance with ASTM D412.
5. Products:
a. Pecora Corporation; Urexpan NR-200: www.pecora.com/#sle.
b. Tremco Commercial Sealants & Waterproofing; THC-901: www.tremcosealants.com/#sle.
c. Substitutions: See Section 1-06.7.

D. Flexible Polyurethane Foam: Single-component, gun grade, and low-expanding.
1. Color: White.
2. Products:
a. Tremco Commercial Sealants & Waterproofing; ExoAir LEF: www.tremcosealants.com/#sle.
b. Substitutions: See Section 1-06.7.

E. High Quality Latex-Based Sound Sealant: ASTM C834, Type OP an opaque sealant, and Grade 0, 32 degrees F (0 degrees C), meets requirements for low-temperature flexibility.
1. Color: White.
2. Products:
a. Everkem Diversified Products, Inc; Sound Seal 90: www.everkemproducts.com/#sle.
b. Substitutions: See Section 1-06.7.

F. Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
1. Composition: Multicomponent, 100 percent solids by weight.
2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
3. Color: To be selected by Contracting Agency from manufacturer's standard colors.
4. Joint Width, Minimum: 1/8 inch (3 mm).
5. Joint Depth: Provide product suitable for joints from 1/8 inch (3 mm) to 2 inches (51 mm) in depth including space for backer rod.
6. Products:
a. Euclid Chemical Company; EUCO 700: www.euclidchemical.com/#sle.
b. W.R. Meadows, Inc; Rezi-Weld Flex: www.wrmeadows.com/#sle.
c. Substitutions: See Section 1-06.7.

2.06 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
   1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
   2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
   3. Open Cell: 40 to 50 percent larger in diameter than joint width.
   4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
   5. Products:
      a. Adfast USA Inc; Adseal BR-2600 Backer Rod: www.adfastcorp.com/#sle.
      b. Substitutions: See Section 1-06.7.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in an inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Install acoustical sealant application work in accordance with ASTM C919.

D. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
   1. Width/depth ratio of 2:1.
   2. Neck dimension no greater than 1/3 of the joint width.
   3. Surface bond area on each side not less than 75 percent of joint width.

E. Install bond breaker backing tape where backer rod cannot be used.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless

manufacturer's approval is obtained and instructions are followed.

H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

I. Size Gun Nozzle to fit Joint.

J. Force Sealant into Joints firmly against Joint Sides to fill Joints and Voids solid; superficial pointing with Skin Bead not acceptable.

K. Prevent 3-sided adhesion of Sealant to Substrate.

L. Install Sealant flush with Adjacent Surface.

M. Within 10 minutes after installation, and using Dry Tool finish Sealant to smooth, uniform, and slightly concave shape.

N. Remove excess Sealant and Masking Materials, if any, immediately after Sealant installation.

O. Leave Sealant Surfaces neat and smooth.

P. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

A. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

B. Repair destructive test location damage immediately after evaluation and recording of results.

3.05 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width, i.e., at low temperature in thermal cycle. Report failures immediately and repair them.

END OF SECTION 07 92 00

This page intentionally left blank

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Hollow metal frames for wood doors.

C. Fire-rated hollow metal doors and frames.

D. Thermally insulated hollow metal doors with frames.

E. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware.

B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.

C. Section 09 90 00 - Painting and Coating: Field painting.

1.03 ABBREVIATIONS AND ACRONYMS

A. ANSI: American National Standards Institute.

B. HMMA: Hollow Metal Manufacturers Association.

C. NAAMM: National Association of Architectural Metal Manufacturers.

D. NFPA: National Fire Protection Association.

E. SDI: Steel Door Institute.

F. UL: Underwriters Laboratories.

1.04 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2022.

C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames 2020.

D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.

E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2020.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.

H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.

J. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames 2016.

K. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

L. ITS (DIR) - Directory of Listed Products Current Edition.

M. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames 2002.

N. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.

O. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames 2017.

P. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames 2014.

Q. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.

R. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2022.

S. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames 2023.

T. UL (DIR) - Online Certifications Directory Current Edition.

U. UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

D. Samples: Submit two samples of metal, 2 by 2 inches (51 by 51 mm) in size, showing factory finishes, colors, and surface texture.

E. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

F. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

G. Manufacturer's Qualification Statement.

H. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide hollow metal doors and frames from SDI Certified manufacturer: https://steeldoor.org/sdi-certified/#sle.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

C. Maintain at project site copies of reference standards relating to installation of products specified.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
   3. Krieger Specialty Products: www.kriegerproducts.com/#sle.
   4. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
   5. Steelcraft, an Allegion brand: www.allegion.com/#sle.
   6. Substitutions: See Section 1-06.7.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:

1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
2. Accessibility: Comply with ICC A117.1 and ADA Standards.
3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
4. Door Edge Profile: Manufacturers standard for application indicated.
5. Typical Door Face Sheets: Flush.
6. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
7. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
    a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 3 - Extra Heavy-duty.
    b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.
    d. Door Face Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
    e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
    a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
3. Door Thermal Resistance: R-Value of Drawings.
4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
5. Weatherstripping: Refer to Section 08 71 00.

C. Interior Doors, Non-Fire-Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 2 - Heavy-duty 3 - Extra Heavy-duty.
    b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.
    d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
    e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

D. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 2 - Heavy-duty 2 - Heavy-duty.

b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 1 - Full Flush.
d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.

2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
3. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
4. Provide units listed and labeled by UL (DIR) or ITS (DIR).
   a. Attach fire rating label to each fire rated unit.
5. Smoke and Draft Control Doors (Indicated with letter "S" on Drawings and/or Door Schedule): Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;
   a. Maximum Air Leakage: 3.0 cfm/sq ft (0.02 cu m/sec/sq m) of door opening at 0.10 inch w.g. (24.9 Pa) pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
   b. Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
   c. Label: Include the "S" label on fire-rating label of door.
6. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
7. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. Exterior Door Frames: Full profile/continuously welded type.
   1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
   2. Frame Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
   3. Weatherstripping: Separate, see Section 08 71 00.

D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
   1. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.

E. Door Frames, Fire-Rated: Full profile/continuously welded type.
   1. Fire Rating: Same as door, labeled.
   2. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.

F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

H. Transom Bars: Fixed, of profile same as jamb and head.

I. Frames Wider than 48 inches (1219 mm): Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

A. Astragals for Double Doors: Specified in Section 08 7100.

B. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.

C. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

D. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Install door hardware as specified in Section 08 71 00.
   1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.

E. Comply with glazing installation requirements of Section 08 80 00.

F. Coordinate installation of electrical connections to electrical hardware items.

G. Touch up damaged factory finishes.

3.03 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.04 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.05 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION 08 11 13

This page intentionally left blank

SECTION 08 14 16
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush configuration; fire-rated and non-rated.

1.02 RELATED REQUIREMENTS

A. Section 08 11 13 - Hollow Metal Doors and Frames.

B. Section 08 71 00 - Door Hardware.

C. Section 09 90 00 - Painting and Coating

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards 2021, with Errata.

C. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2022.

D. UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
   1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
   2. Include certification program label.

D. Samples: Submit two samples of door construction, 6 by 6 inches (c by 153 mm) in size cut from top corner of door.

E. Samples: Submit two samples of door veneer, 6 by 6 inches (153 by 153 mm) in size illustrating wood grain, stain color, and sheen.

F. Manufacturer's Installation Instructions: Indicate special installation instructions.

G. Manufacturer's qualification statement.

H. Installer's qualification statement.

I. Specimen warranty.

J. Warranty, executed in Contracting Agency's name.

1.05 QUALITY ASSURANCE

A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than seven years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging, and inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.07 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in Contracting Agency's name and register with manufacturer.
   1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Haley Brothers: www.haleybros.com/#sle.
   2. Masonite Architectural: www.architectural.masonite.com/#sle.
   3. Oregon Door: www.oregondoor.com/#sle.
   4. VT Industries, Inc: www.vtindustries.com/#sle.
   5. Substitutions: See Section 1-06.7.

2.02 DOORS

A. Doors: See drawings for locations and additional requirements.
   1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
   2. Wood Veneer Faced Doors: 5-ply or 7-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location, as noted in the door schedule on the drawings.
   2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
   3. Smoke and Draft Control Doors (Indicated as "S" on Drawings): In addition to required fire rating, provide door assemblies tested in accordance with UL 1784 with maximum air leakage of 3.0 cfm per sq ft (0.01524 cu m/s/sq m) of door opening at 0.10 inch wg (24.9 Pa) pressure at both ambient and elevated temperatures for "S" label; if necessary, provide additional gasketing or edge sealing.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish: Red oak, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
   1. Vertical Edges: Any option allowed by quality standard for grade.
   2. "Running Match" each pair of doors and doors in close proximity to each other.

B. Facing Adhesive: Type I - waterproof.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:
   1. Provide solid blocks at lock edge for hardware reinforcement.

C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

E. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 1, Lacquer, Nitrocellulose.
      b. Stain: As selected by Contracting Agency.
      c. Sheen: Semigloss.

B. Seal door top edge with color sealer to match door facing.

2.07 ACCESSORIES

A. Hollow Metal Door Frames: See Section 08 11 13.

B. Door Hardware: See Section 08 71 00.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.
   2. Install smoke and draft control doors in accordance with NFPA 105 requirements.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

3.03 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

3.05 SCHEDULE - SEE DRAWINGS

END OF SECTION 08 14 16

This page intentionally left blank

SECTION 08 31 00
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall- and ceiling-mounted access units.

1.02 RELATED REQUIREMENTS

A. Section 09 90 00 - Paint and Coating: Field paint finish.

1.03 REFERENCE STANDARDS

A. ITS (DIR) - Directory of Listed Products Current Edition.

B. UL (FRD) - Fire Resistance Directory Current Edition.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

C. Manufacturer's Installation Instructions: Indicate installation requirements.

D. Project Record Documents: Record actual locations of each access unit.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

A. Wall-Mounted Units in Wet Areas:
   1. Panel Material: Steel, hot-dipped zinc, or zinc-aluminum-alloy coated.
   2. Size: 12 by 12 inches (305 by 305 mm) or as required.
   3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
   4. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
   5. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.

B. Fire-Rated Wall-Mounted Units:
   1. Wall Fire-Rating: As indicated on drawings.
   2. Panel Material: Steel.
   3. Size: 12 by 12 inches (305 by 305 mm) or as required.
   4. Door/Panel: Insulated double-surface panel, with tool-operated spring or cam lock and no handle.

C. Ceiling-Mounted Units:
   1. Panel Material: Steel.
   2. Size - Other Ceilings: 12 by 12 inches (305 by 305 mm) or as required.
   3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

D. Fire-Rated Ceiling-Mounted Units:
   1. Ceiling Fire-Rating: As indicated on drawings.
   2. Panel Material: Steel.
   3. Size: 12 by 12 inches (305 by 305 mm) or as required.
   4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

2.02 WALL- AND CEILING-MOUNTED ACCESS UNITS

A. Manufacturers:

1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com/#sle.
2. ACUDOR Products Inc: www.acudor.com/#sle.
3. Best Access Doors: www.bestaccessdoors.com/#sle.
4. Cendrex, Inc: www.cendrex.com/#sle.
5. Nystrom, Inc: www.nystrom.com/#sle.
6. Studco Building Systems; EZConcept AccessDor : www.studcosystems.com/#sle.
7. Substitutions: See Section 1-06.7.

B. Wall- and Ceiling-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
   1. Style: Exposed frame with door surface flush with frame surface.
      a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
   2. Door Style: Single thickness with rolled or turned in edges.
   3. Heavy-Duty Frames: 14-gauge, 0.0747-inch (1.89 mm) minimum thickness.
   4. Single Steel Sheet Door Panels: 16-gauge, 0,0625-inch (1.6 mm) minimum thickness.
   5. Insulation: Non-combustible mineral wool or glass fiber.
   6. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
      a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
   7. Steel Finish: Primed.
   8. Hardware:
      a. Hardware for Fire-Rated Units: As required for listing.
      b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
      c. Latch/Lock: Tamperproof tool-operated cam latch.
      d. Gasketing: Extruded neoprene, around perimeter of door panel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Contracting Agency of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 08 31 00

SECTION 08 33 23
OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire-rated coiling doors.

B. Electric operators and control stations.

C. Wiring from electric circuit disconnect to operators and control stations.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

D. ITS (DIR) - Directory of Listed Products Current Edition.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts 2008 (Reaffirmed 2020).

G. NEMA MG 1 - Motors and Generators 2021.

H. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.

I. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2022.

J. UL (DIR) - Online Certifications Directory Current Edition.

K. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems Current Edition, Including All Revisions.

L. UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide general construction, electrical equipment, and component connections and details.

C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

D. Samples: Two slats, 6 by 6 inches (152 by 152 mm) in size illustrating shape, color and finish texture.

E. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.

F. Manufacturer's qualification statement.

G. Installer's qualification statement.

H. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

I. Specimen warranty.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least five years documented experience.

C. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified and indicated.

1.06 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Manufacturer Warranty: Provide 2-year manufacturer warranty for roller shaft counterbalance assembly. Complete forms in Contracting Agency's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: 631 Fire King Door manufactured by Overhead Door Corporation.

B. Overhead Coiling Fire Doors:
1. Clopay Building Products: www.clopaydoor.com/#sle.
2. The Cookson Company: www.cooksondoor.com/#sle.
3. Wayne-Dalton, a Division of Overhead Door Corporation: www.wayne-dalton.com/#sle.
4. Overhead Door Corporation: www.overheaddoor.com/#sle.
5. Substitutions: See Section 1-06.7.

2.02 COILING DOORS

A. Fire-Rated Coiling Doors: Steel slat curtain; comply with NFPA 80.
1. 1-1/2 hour fire rating.
   a. Provide smoke and draft control door assemblies tested in accordance with UL 1784.
2. Provide products listed and labeled by ITS (DIR) or UL (DIR) as suitable for purpose specified and indicated on drawings.
3. Oversized Openings: Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated units and operating hardware assembly.
4. Single Thickness Slats: Manufacturer's standard.
5. Nominal Slat Size: 2 inches (50 mm) wide by required length.
6. Finish: Factory painted, color as selected.
7. Guides, Angles: Galvanized steel.
8. Hood Enclosure: Manufacturer's standard; galvanized steel.
9. Fire Alarm Release Mechanism: Electric-motor operated from fire alarm system and local heat or smoke detectors.
   a. Provide fail-secure, fail-closed, locking device upon power loss.
   b. Provide 10 second time delay for activation upon loss of power.
   c. Provide resettable device without replacement of parts, except when release triggered by exposure to local heat.
10. Electric operation.
11. Mounting: Surface mounted.

2.03 MATERIALS AND COMPONENTS

A. Metal Curtain Construction: Interlocking slats.
1. Curtain Bottom for Slat Curtains: Fitted with angles to provide reinforcement and positive contact in closed position.
2. Smoke Seals: Provide brush or gasket type weatherstripping seals to prevent passage of smoke and hot gases in compliance with UL 1784 testing requirements.
3. Steel Slats: Minimum thickness, 20 gauge, 0.0396 inch (1.0058mm mm); ASTM A653/A653M galvanized steel sheet.
   a. Galvanizing: Minimum G90 (Z275) coating.

B. Guide Construction: Continuous, of profile to retain door in place with snap-on trim, mounting brackets of same metal.

C. Guides - Angle: Manufacturer's standard to size and weight of door.

1. Hot-dip galvanized in compliance with ASTM A123/A123M.

D. Hood Enclosure and Trim: Internally reinforced to maintain rigidity and shape.

E. Lock Hardware:
   1. For motor operated units, additional lock or latching mechanisms are not required.

F. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb (10 kg) nominal force to operate.

2.04 ELECTRIC OPERATION

A. Basis of Design Operator: RSX Standard Duty Commercial Operator manufactured by Overhead Door Corporation.

B. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
   1. Provide interlock switches on motor operated units.
   2. Provide tamperproof operation cycle counter.

C. Electric Operators:
   1. Mounting: Side mounted.
   2. Motor Enclosure:
      a. Interior Coiling Doors: NEMA MG 1, Type 1; open drip proof.
   3. Motor Rating: Minimum 3/4 HP (560 W); continuous duty.
   4. Motor Voltage: 120 volts, single phase, 60 Hz.
   5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
   6. Controller Enclosure: NEMA 250, Type 4.
   7. Opening Speed: 12 inches per second (300 mm/sec).
   8. Brake: Manufacturer's standard type, activated by motor controller.
   9. Provide manual override in case of power failure.
   10. Provide manufacturer's standard manual operation device for cases of power failure.

D. Control Station: Provide standard three button, 'Open-Close-Stop' momentary-contact control device for each operator complying with UL 325.
   1. 24 volt circuit.
   2. Surface mounted, at interior door jamb.
   3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
      a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.

E. Safety Edge: Located at bottom of coiling door, full width, electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object, hollow neoprene covered.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that adjacent construction is suitable for door installation.

B. Verify that electrical services have been installed and are accessible.

C. Verify that door opening is plumb, header is level, and dimensions are correct.

D. Notify Contracting Agency of any unacceptable conditions or varying dimensions.

E. Commencement of installation indicates acceptance of substrate and door opening conditions.

3.02 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install fire-rated doors in accordance with NFPA 80.

C. Install smoke door assemblies in accordance with NFPA 105.

D. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

E. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

F. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

G. Complete wiring from disconnect to unit components.

H. Complete wiring from fire alarm system.

I. Install enclosure and perimeter trim.

3.03 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation From Plumb: 1/16 inch (1.6 mm).

C. Maximum Variation From Level: 1/16 inch (1.6 mm).

D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet (3.2 mm per 3 m) straight edge.

3.04 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

A. Clean installed components.

B. Remove labels and visible markings.

END OF SECTION 08 33 23

SECTION 08 36 13
SECTIONAL DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Overhead sectional doors, electrically operated.

B. Operating hardware and supports.

C. Electrical controls.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.

1.03 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.

C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.

D. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2004 (Reapproved 2012).

E. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014 (Reapproved 2021).

F. DASMA 102 - American National Standard Specifications for Sectional Doors 2018.

G. ITS (DIR) - Directory of Listed Products Current Edition.

H. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts 2008 (Reaffirmed 2020).

I. NEMA MG 1 - Motors and Generators 2021.

J. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

K. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL (DIR) - Online Certifications Directory Current Edition.

M. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.

C. Product Data: Show component construction, anchorage method, and hardware.

D. Samples: Submit two panel finish samples, 6 by 6 inch (152 by 152 mm) in size, illustrating color and finish.

E. Manufacturer's Installation Instructions: Include any special procedures required by project conditions.

F. Manufacturer's Qualification Statement.

G. Installer's Qualification Statement.

H. Operation Data: Include normal operation, troubleshooting, and adjusting.

I. Maintenance Data: Include data for motor and transmission, shaft and gearing, lubrication frequency, spare part sources.

J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Contracting Agency's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least five years documented experience.

C. Comply with applicable code for motor and motor control requirements.

D. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction, as suitable for purpose specified.

1.06 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for electric motor and transmission.

D. Provide five year manufacturer warranty for electric operating equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: 596 Extra Heavy-Duty Thermacore® Doors manufactured by Overhead Door Corporation.

B. Other Acceptable Manufacturers - Sectional Doors:
1. Clopay Building Products; Model 3720: www.clopaydoor.com/#sle.
2. Wayne-Dalton, a Division of Overhead Door Corporation: www.wayne-dalton.com/#sle.
3. Overhead Door Corporation: www.overheaddoor.com/#sle.
4. CornellCookson, LLC.: https://www.cooksondoor.com/#sle.
5. Substitutions: See Section 1-06.7.

2.02 STEEL DOORS

A. Steel Doors: Flush steel, insulated; standard lift operating style with track and hardware; complying with DASMA 102, Commercial application.
1. Performance: Withstand positive and negative wind loads equal to 1.5 times design wind loads specified by local code without damage or permanent set, when tested in accordance with ASTM E330/E330M, using 10 second duration of maximum load.
2. Door Nominal Thickness: 2 inches (51 mm) thick.
3. Thermal Transmittance: U-factor (Usi-factor) of 0.057 Btu/hr sq ft degrees F (0.327 W/sq m K), maximum, in accordance with DASMA 102 unless more stringent requirements are spelled out in the Drawings.
4. Air Leakage Rate: Less than 0.13 cfm/sf (0.64 L/sec/sq m) when tested in accordance with ASTM E283 at test pressure difference of 1.57 psf (75 Pa).
5. Exterior Finish: Factory finished with polyester baked enamel; as selected by Contracting Agency.
6. Interior Finish: Factory finished with polyester baked enamel; color as selected from manufacturers standard line.
7. Glazed Lights: Two glazed lights per panel, two row; set in place with resilient glazing channel.
8. Electric Operation: Electric control station.

B. Door Panels: Steel construction; outer steel sheet of 20 gauge, 0.0359 inch (0.91 mm) minimum thickness, flush profile; inner steel sheet of 20 gauge, 0.0359 inch (0.91 mm) minimum thickness, flat profile; core reinforcement sheet steel roll formed to channel shape, rabbeted weather joints at meeting rails; polyurethane insulation.

C. Window Frame: To match door panels, finish to match per Drawings.

D. Glazing: Heat-strengthened glass; insulated glass units; clear; 1 inch (25.4 mm) overall thickness.

2.03 COMPONENTS

A. Track: Rolled galvanized steel, 0.120 inch (3.0 mm) minimum thickness; 3 inch (75 mm) wide, continuous one piece per side; galvanized steel mounting brackets 1/4 inch (6 mm) thick.

B. Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of galvanized steel; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.

C. Lift Mechanism: Torsion spring on cross head shaft.

D. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.

E. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.

F. Head Weatherstripping: EPDM rubber seal, one piece full length.

G. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.

H. Lock: Inside side mounted, adjustable keeper, spring activated latch bar with feature to retain in locked or retracted position; interior and exterior handle.

I. Lock Cylinders: Keyed alike.

2.04 MATERIALS

A. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G60/Z180 coating, plain surface.

B. Aluminum Sheet: ASTM B209/B209M, 5005 alloy, H14 temper, plain surface.

C. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

D. Float Glass: Provide float glass glazing, unless noted otherwise.
   1. Heat-Strengthened and Fully Tempered Types: ASTM C1048.

E. Insulation: Foamed-in-place polyurethane, bonded to facing.
   1. Same thickness as core framing members.

F. Metal Primer Paint: Zinc molybdate type.

2.05 ELECTRIC OPERATION

A. Basis of Design Operator: RXH Heavy Duty Commercial Operator manufactured by Overhead Door Corporation.

B. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
   1. Provide interlock switches on motor operated units.
   2. Provide tamperproof operation cycle counter.

C. Electric Operators:
   1. Mounting: Side mounted on cross head shaft.
   2. Motor Enclosure:
      a. Exterior Doors: NEMA MG 1, Type 4; open drip proof.
   3. Motor Rating: Minimum 3/4 hp (560 W); continuous duty.
   4. Motor Voltage: 120 volts, single phase, 60 Hz.
   5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
   6. Controller Enclosure: NEMA 250, Type 1.
   7. Opening Speed: 12 inches per second (300 mm/s).
   8. Brake: Adjustable friction clutch type, activated by motor controller.
   9. Provide manual override in case of power failure.
   10. Provide manufacturer's standard manual operation device for cases of power failure.

D. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated; enclose terminal lugs in terminal box sized to comply with NFPA 70.

E. Control Station: Provide standard three button (Open-Close-Stop) momentary-contact control device for each operator complying with UL 325.
   1. 24 volt circuit.
   2. Surface mounted, at interior door jamb.
   3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
      a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.

F. Safety Edge: Located at bottom of sectional door panel, full width; electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object; hollow neoprene covered to provide weatherstrip seal.

G. Safety Edge: Located at bottom of sectional door panel, full width; electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object; hollow neoprene covered to provide weatherstrip seal.

H. Provide interconnection to security system.

I. Hand Held Transmitter: Digital control, and resettable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

B. Verify that electric power is available and of the correct characteristics.

3.02 PREPARATION

A. Prepare opening to permit correct installation of door unit to perimeter air and vapor barrier seal.

B. Apply primer to wood frame.

3.03 INSTALLATION

A. Install door unit assembly in accordance with manufacturer's instructions.

B. Anchor assembly to wall construction and building framing without distortion or stress.

C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.

D. Fit and align door assembly including hardware.

E. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

F. Install perimeter trim.

3.04 TOLERANCES

A. Maximum Variation from Plumb: 1/16 inch (1.5 mm).

B. Maximum Variation from Level: 1/16 inch (1.5 mm).

C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch (3 mm) from 10 ft (3 m) straight edge.

D. Maintain dimensional tolerances and alignment with adjacent work.

3.05 ADJUSTING

A. Adjust door assembly for smooth operation and full contact with weatherstripping.

B. Notify Owner/Owner Representative 24-48 hours in advance and have manufacturer's field representative present to confirm proper operation and identify adjustments to door assembly for specified operation.

3.06 CLEANING

A. Clean doors and frames and glazing.

B. Remove temporary labels and visible markings.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

B. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

END OF SECTION 08 36 13

This page intentionally left blank

SECTION 08 42 29
AUTOMATIC ENTRANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sliding type packaged power-operated door assemblies.

B. Controllers, actuators and safety devices.

1.02 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

B. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2019.

C. BHMA A156.10 - Power Operated Pedestrian Doors 2017.

D. ITS (DIR) - Directory of Listed Products Current Edition.

E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL (DIR) - Online Certifications Directory Current Edition.

H. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Shop Drawings:
   1. Indicate layout and dimensions; head, jamb, and sill conditions; elevations; components, anchorage, recesses, materials, and finishes, electrical characteristics and connection requirements.
   2. Identify installation tolerances required, assembly conditions, routing of service lines and conduit, and locations of operating components and boxes.

C. Product Data: Include system components, sizes, features, and finishes.

D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and manufacturer's hardware and component templates.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

G. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

H. Maintenance Data: Include manufacturer's parts list and maintenance instructions for each type of hardware and operating component.

I. Executed warranty.

J. Specimen warranty.

K. Maintenance Materials: Furnish the following for Contracting Agency's use in maintenance of project.
   1. Wrenches and other tools required for maintenance of equipment.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience, and a member of AAADM.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience and approved by manufacturer.
   1. Certified by AAADM.

1.06 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Manufacturer Warranty: Provide 2-year manufacturer warranty for sliding doors and operators. Complete forms in Contracting Agency's name and register with manufacturer.

C. Extended Correction Period: Correct defective work within 5-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sliding Automatic Entrance Door Assemblies: Basis of Design Manufacturer and Product Stanley Access Technologies; Dura-Guard 2000; www.stanleyaccess.com/#sle

B. Sliding Automatic Entrance Door Manufacturers:
   1. ASSA ABLOY Entrance Solutions: www.besam-usa.com/#sle.
   2. DORMA USA, Inc: www.dorma.com/#sle.
   3. Horton Automatics, a division of Overhead Door Corporation: www.hortondoors.com/#sle.
   4. NABCO Entrances Inc: www.nabcoentrances.com/#sle.
   5. Portalp USA: www.portalpusa.com/#sle.
   6. record-usa: www.recorddoors.com/#sle.
   7. Stanley Access Technologies: www.stanleyaccess.com/#sle.
   8. Substitutions: See Section 1-06.7.

2.02 POWER OPERATED DOORS

A. Power Operated Doors: Provide products that comply with NFPA 101 and requirements of authorities having jurisdiction; provide equipment selected for actual door weight and for light pedestrian traffic, unless otherwise indicated.
   1. Packaged Door Assemblies: Provide components by single manufacturer, factory-assembled, including doors, frames, operators, actuators, and safeties.
   2. Air Leakage: Maximum of 1.0 cfm/sf (5.0 L/sec/sq m) of wall area, when tested in accordance with ASTM E283/E283M at 1.57 psf (75 Pa) pressure differential across assembly.
   3. Exterior and Vestibule Doors: Provide equipment suitable for operating temperature range of minus 20 to plus 140 degrees F (minus 29 to plus 60 degrees C) ambient.

B. Sliding and Folding Doors with Full Power Operators: Comply with BHMA A156.10; safeties required; provide break-away operation unless otherwise indicated; in the event of break-away operation, interrupt power operation.
   1. Comply with UL 325; acceptable evidence of compliance includes UL (DIR) or ITS (DIR) listing or test report by testing agency acceptable to authorities having jurisdiction.
   2. Force Required to Swing Break-Away Panel: 50 pound-force (220 N), maximum, measured at 1 inch (25 mm) from the latch edge of the door at any point in the closing cycle.

C. Operators:
   1. Electric Operators: 1/4 hp (186.4 W) minimum, self-contained, gear driven.

2.03 AUTOMATIC ENTRANCE DOOR ASSEMBLIES

A. Comply with ADA Standards for egress requirements.

B. Framing Members: Provide manufacturer's standard extruded aluminum framing, reinforced as required to support imposed loads.
   1. Nominal Sizes:
      a. Single Slide and Bi-Parting Sliding Doors: 1-3/4 inch (44.5 mm) wide by 4-1/2 inch (114.3 mm) deep.

C. Door and Sidelight Construction: Heavy duty interlocked extruded aluminum tubular stile and rail sections, through-rod bolted construction with steel corner support at hinge stile of carrier-suspended swinging panels or mechanically fastened corners with welded reinforcing brackets to reduce sag in sliding or breakout mode.
   1. Door Thickness: 1-3/4 inch (44.5 mm), nominal.
   2. Stile Design:
      a. Medium stile, 3-1/2 inch (89 mm), nominal width.
   3. Top Rail Height: 4 inch (102 mm), nominal.
   4. Center Rail (Muntin Bar) Height: 6 inch (152 mm), nominal.
   5. Bottom Rail Height: 10 inch (254 mm), nominal.
   6. Glazing Stops: Manufacturer's standard snap-on extruded aluminum square stops with preformed resilient glazing gaskets.
   7. Glazing Stop Width: Manufacturers standard.
   8. Glazing Thickness: 5/8 inch (16 mm).

D. Sliding Automatic Door: Bi-parting double leaf track-mounted, electric operation, extruded aluminum glazed door, with frame, and operator concealed overhead.
   1. Operation: Power open, electric operation.
   2. Exterior-Side Actuator/Safety: Motion sensor.
   3. Interior-Side Actuator/Safety: Motion sensor.
   4. Hold Open: Toggle switch at inside head of doors; this is not a fire-rated door.
   5. Door and Frame Finish: Anodized, clear.

2.04 CONTROLLERS, ACTUATORS, AND SAFETIES

A. Controller: Provide microprocessor operated controller for each door.

B. Comply with BHMA A156.10 for actuator and safety types and zones.

2.05 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Provide shielded electrical devices at door location.

B. Electrical Characteristics:
   1. 1/4 hp (186.4 W).

C. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

D. Disconnect Switch: Factory mount disconnect switch in control panel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.

B. Verify that electric power is available, at the correct location, and is of the correct characteristics.

3.02 INSTALLATION

A. Install equipment in accordance with manufacturer's written instructions, except where more stringent requirements are specified.

B. Install entrances securely anchored in place, plumb, level, and true to location, in alignment with established lines and grades, without warp, bow, or racking of members.

C. Where frames are assembled in field, fit frame joints hairline tight without burrs or distortion; rigidly secure nonmoving joints and seal watertight.

D. Provide for thermal expansion and contraction of door and frame units and live and dead loads that may be transmitted to operating equipment.

E. Provide for dimensional distortion of components during operation.

F. Coordinate installation of components with related and adjacent work; level and plumb.

3.03 ADJUSTING

A. Adjust entrances for correct function and smooth operation, without binding or scraping and without excessive noise; lubricate operating hardware and other moving parts.

3.04 CLEANING

A. Remove temporary protection; clean exposed surfaces.

3.05 CLOSEOUT ACTIVITIES

A. Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.06 MAINTENANCE

A. Provide service and maintenance of operating equipment for one year from Date of Substantial Completion, at no extra charge to Contracting Agency.

END OF SECTION 08 42 29

SECTION 08 43 13
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Aluminum doors and frames.

C. Weatherstripping.

1.02 RELATED REQUIREMENTS

A. Section 05 12 00 - Structural Steel Framing: Steel attachment members.

B. Section 07 25 00 - Weather Barriers: Sealing framing to water-resistive barrier installed on adjacent construction.

C. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.

D. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site 2015.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems 2015.

C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems 2014.

D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.

E. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2020.

F. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections 2009.

G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

H. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.

I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.

J. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.

K. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2019.

L. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014 (Reapproved 2021).

M. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2023).

N. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors 2002 (Reapproved 2018).

O. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference 2015 (Reapproved 2023).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
   1. Include design engineer's stamp or seal on shop drawings for attachments and anchors.

D. Samples: Submit two samples 6 x 6 inches (152 x 152 mm) in size illustrating finished aluminum surface, glass, glazing materials.

E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

F. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

G. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

H. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

I. Designer's qualification statement.

J. Manufacturer's qualification statement.

K. Installer's qualification statement.

L. Specimen warranty.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least seven years of documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
      a. Insulating Glass Certification Council (IGCC).
      b. Safety Glazing Certification Council (SGCC).

C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
   1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
      a. North American Contractor Certification (NACC) for glazing contractors.
      b. Equivalent independent third-party ANSI accredited certification.

1.07 MOCK-UPS

A. See Section 1-06.8 for additional mock-up requirements.

B. Construct two storefront mock-ups, 10 feet (3.05 m) long by 20 feet (6.1 m) high, indicating storefront window wall head, jamb, sill and storefront door head, jamb, sill at an interior and exterior storefront location.

C. Mock-up may remain as part of work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.09 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.10 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum-Framed Storefronts Manufacturers:
   1. Arcadia, Inc: www.arcadiainc.com/#sle.
   2. Coral Architectural Products, a division of Coral Industries, Inc: www.coralap.com/#sle.
   3. Kawneer North America: www.kawneer.com/#sle.
   4. Oldcastle BuildingEnvelope: www.oldcastlebe.com/#sle.
   5. Tubelite, Inc: www.tubeliteinc.com/#sle.
   6. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com/#sle.
   7. Substitutions: See Section 1-06.7.

2.02 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

A. Front-Set Style, Thermally-Broken:
   1. Basis of Design: Kawneer North America; Trifab® VersaGlaze® 451 (Interior)/451T (Exterior) Framing Systems: www.kawneer.com .
   2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep (50 mm wide by 114 mm deep).

B. Substitutions: See Section 1-06.7.
   1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.03 SWINGING DOORS

A. Narrow Stile, Glazed:
   1. Basis of Design Interior: Kawneer North America; 190 Standard Entrances.
   2. Thickness: 2 1/8 inches (54 mm).

B. Narrow Stile, Insulating Glazing, Thermally-Broken:
   1. Basis of Design Exterior: Kawneer North America; 250T Insulpour® Thermal Entrances.
   2. Thickness: 2-1/4 inches (57.1 mm).

C. Substitutions: See Section 1-06.7.
   1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.04 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Finish: Class I natural anodized for exterior and interior storefronts and entrance doors.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
   2. Finish Color: Clear.
   3. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.

4. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
6. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
7. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
9. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel, and heel bead of glazing compound.
10. Preparation for Window Treatments: Provide reinforced interior horizontal head rail.

2.05 PERFORMANCE REQUIREMENTS

A. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   1. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.

B. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf (390 Pa).

C. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf (75 Pa) pressure difference.

D. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf (75 Pa) pressure difference.

E. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.

F. Overall U-value Including Glazing: See Drawings.

2.06 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
   1. Framing members for interior applications need not be thermally broken.
   2. Glazing Stops: Flush.

B. Glazing: See Section 08 80 00.

C. Swing Doors: Glazed aluminum.
   1. Thickness: 2 1/4 inches (57 mm) at exterior and 1 3/4 inches (43 mm) at interior doors.
   2. Bottom Rail: 10 inches (254 mm) wide.
   3. Glazing Stops: Square.
   4. Finish: Same as storefront.

2.07 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209/B209M.

C. Structural Steel Sections: ASTM A36/A36M; shop primed.

D. Structural Supporting Anchors: See Section 05 12 00.

E. Fasteners: Stainless steel.

F. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch (0.81 mm) minimum thickness; finish to match framing members.

G. Concealed Flashings: Sheet aluminum, 26 gauge, 0.017 inch (0.43 mm) minimum thickness.

H. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.

I. Sealant for Setting Thresholds: Non-curing butyl type.

J. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

K. Glazing Accessories: See Section 08 80 00.

L. Shop and Touch-Up Primer for Steel Components: Zinc oxide, alkyd, linseed oil primer appropriate for use over hand cleaned steel.

2.08 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

B. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.09 HARDWARE

A. For each door, include weatherstripping, sill sweep strip, and threshold.

B. Other Door Hardware: See Section 08 71 00.

C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.

E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Set thresholds in bed of sealant and secure.

J. Install glass using glazing method required to achieve performance criteria; see Section 08 80 00.

K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.04 FIELD QUALITY CONTROL

A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.

B. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
   1. Perform a minimum of two tests in each designated area as indicated on drawings.
   2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.

C. Provide field testing of installed storefront system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
   1. Perform a minimum of two tests in each designated area as indicated on drawings.
   2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
   3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf (200 Pa).
      a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce (14 gram) that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
   4. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 1.57 psf (75 Pa).
      a. Maximum allowable rate of air leakage is 0.09 cfm/sq ft (0.5 L/s sq m).

D. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating hardware for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 08 43 13

SECTION 08 45 00
TRANSLUCENT WALL AND ROOF ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sandwich panel translucent wall system.

1.02 RELATED REQUIREMENTS

A. Section 07 25 00 - Weather Barriers: Sealing perimeter frame to water-resistive barrier installed on adjacent construction.

B. Section 07 84 00 - Firestopping.

C. Section 07 92 00 - Joint Sealants: Sealing joints between perimeter frame and adjacent construction.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site 2015.

B. AAMA CWM - Curtain Wall Manual 2019.

C. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems 2015.

D. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2020.

E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

H. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.

I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.

J. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.

K. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position 2022.

L. ASTM D638 - Standard Test Method for Tensile Properties of Plastics 2022.

M. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials 2017.

N. ASTM D1003 - Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics 2021.

O. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates 2022.

P. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.

Q. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2019.

R. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014 (Reapproved 2021).

S. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2023).

T. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of firestopping and water-resistive barrier.

B. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, panel configuration, and internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, weep drainage network, expansion and contraction joint locations and details, and required field welding.

D. Samples: Two panels, 12 by 24 inches (305 by 610 mm) in size, illustrating prefinished aluminum surface, specified panel with skins, glazing materials illustrating edge and corner.

E. Design Data: Show structural and physical characteristics, engineering calculations, and dimensional limitations.

F. Test Reports: Substantiating engineering data, test results of previous tests by independent laboratory demonstrating compliance with performance requirements.

G. Installation Data: Special installation requirements.

H. Designer's qualification statement.

I. Manufacturer's qualification statement.

J. Installer's qualification statement.

K. Specimen warranty.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with AAMA CWM.

B. Designer Qualifications: Design structural support framing components under direct supervision of Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

D. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

1.07 MOCK-UPS

A. See Section 1-06.8 for additional mock-up requirements.

B. Provide a mock-up, 12 ft (3.66 m) long by 4 ft (1.22 m) wide, include translucent panels, intermediate mullion, sill muntin, and insulated infill. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.

C. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Handle work of this section in accordance with AAMA CW-10.

B. Store panels on long edge above ground, blocked and under cover in accordance with manufacturer’s storage and handling instructions.

C. Protect prefinished aluminum surfaces with wrapping; do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.
   1. Puncture wrappings at ends for ventilation.

1.09 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C).

B. Maintain this minimum temperature during and after installation of sealants.

1.10 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

C. Manufacturer Warranty: Provide 5-year manufacturer warranty against failure of insulated translucent sandwich panels, including excessive deflection, defects in accessories, and other components. Complete forms in Contracting Agency's name and register with manufacturer.

D. Manufacturer Warranty: Provide 10-year manufacturer warranty against deterioration of interior and exterior polycarbonate glazing panes. Complete forms in Contracting Agency's name and register with manufacturer. Include coverage for the following characteristics:
   1. Change in Light Transmission: No greater than 6 percent when tested in accordance with ASTM D1003.
   2. Color Stability of Glazing: Color change no greater 6 CIE Units DELTA E when evaluated according to ASTM D2244.

E. Manufacturer Warranty: Provide 20-year manufacturer warranty against excessive degradation of exterior finish; include provision for replacement of units with excessive cracking, peeling, and adhesion failure of finish. Complete forms in Contracting Agency's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sandwich Panel - Translucent Wall Systems:
   1. Enduro Composites, Inc: www.endurocomposites.com/#sle
   2. Kalwall Corporation: www.kalwall.com/#sle.
   3. Major Industries, Inc: www.majorskylights.com/#sle.
   4. Substitutions: See Section 1-06.7.

B. Basis of Design Manufacturer and Products:
   1. Thermally Broken Locations: Kalwall Corporation; Thermal Broken Wall Systems; www.kalwall.com/#sle.
   2. Non-Thermally Broken Locations: Kalwall Corporation; Standard Wall Systems; www.kalwall.com/#sle.

2.02 DESIGN CRITERIA

A. System Design: Design and size assemblies and their components to withstand dead loads and live loads caused by snow, hail, and positive and negative wind loads acting on plane of panel without damage or permanent set.
   1. Regulatory Requirements: Comply with applicable code criteria for loads, including seismic loads and energy requirements.
   2. Design Loads and Energy Requirements: As indicated on drawings.

2.03 PERFORMANCE REQUIREMENTS

A. Measure structural performance in accordance with ASTM E330/E330M, using test load of 1.5 times the design wind pressure and 10 second duration of maximum load.

B. Deflection: Limit panel mullion deflection to L/60 with full recovery of glazing materials.

C. System Assembly: Accommodate without damage to system, components or deterioration of seals; movement within system; movement between system and perimeter framing components; dynamic loading and release of loads; deflection of structural support framing, tolerance of supporting components, shortening of building concrete structural columns.

D. Color Stability: Color of exterior face sheet to not change color more than three CIE Units DELTA E in accordance with ASTM D2244 after 3 years outdoors in South Florida weathering

facing south; color stability is not affected by abrasion or scratching.

E. Thermal Resistance of Panel System (Excluding Vision Areas): As noted on Drawings.

F. Air Leakage: Limit air leakage through assembly to 0.06 cu ft/min sq ft (0.30 L/sec sq m) of sloped glazed area, measured at pressure differential across assembly of 1.57 psf (75 Pa) in accordance with ASTM E283/E283M.

G. Static Pressure Vapor Seal: Provide vapor seal that maintains interior static pressure of at least 1 inch (25.4 mm) water column (WC) at 72 degrees F (22 degrees C) and 40 percent relative humidity.

H. Water Leakage: None, when measured in accordance with ASTM E331 at a test pressure difference of 2.86 psf (140 Pa).

I. Expansion/Contraction: System to provide for expansion and contraction within system components caused by a cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components.

J. System Internal Drainage: Drain water entering joints, condensation occurring in framing system, or migrating moisture occurring within system, to the exterior by a weep drainage network.

K. Fabricate to prevent vibration harmonics, thermal movement transmitted to other building elements, and loosening, weakening, or fracturing of attachments or components of system.

2.04 SYSTEMS

A. General: Shop-fabricated, factory-prefinished facade and roof systems consisting of various types of translucent assemblies, internal and external framing components, accessories, related flashings, anchorages, and attachments.

B. Sandwich Panel Translucent Wall Systems: Structurally reinforced translucent panel assemblies, with self-supporting panel framing, insulation, and internal grid of stiffener battens.

2.05 ASSEMBLIES

A. Sandwich Panel Assemblies: Bonded to both sides of structural extruded aluminum grid with manufacturer's standard pattern; exposed surfaces of exterior sheet chemically and permanently treated to protect against surface erosion and extreme weather conditions; polyvinyl fluoride film coated.
   1. Sandwich Panel Insulation: Manufacturer's standard translucent type, with substantive thermal and acoustical properties for thermally broken panels.
      a. Type: Glass fiber or silica aerogel.
      b. Thermal Performance: See Drawings.
   2. Sandwich Panel Face Sheets: Fiberglass reinforced polymer (FRP).
      a. Type: Flat panel.
      b. Exterior Face Sheet: Translucent, and smooth.
         1) Color: Manufacturer's standard.
         2) Thickness: 0.070 inch (1.78 mm), minimum.
      c. Interior Face Sheet: Translucent, and smooth.
         1) Color: Manufacturer's standard.
         2) Thickness: 0.3125 inch (8 mm), minimum.
         3) Provide exposed surface of interior face sheets with Flame Spread Index (FSI) of less than 25 and Smoke Developed Index (SDI) of less than 450 in accordance with ASTM E84 and UL 723.
         4) Provide face sheets with burn extent no greater than 1 inch (25.4 mm) complying with ASTM D635.
   3. Performance for Thermally Broken Panels:
      a. Center of Glazing U-Value: See Drawings.
      b. Overall Light Transmittance (LT): See Drawings.
      c. Overall Shading Coefficient: See Drawings.
      d. Overall Solar Heat Gain Coefficient (SHGC): See Drawings

B. Firestopping: Provide firestopping sealants as required for assemblies; see Section 07 84 00.

2.06 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209/B209M.

C. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

D. Steel Sections: ASTM A36/A36M; shaped to suit mullion sections.

E. Fiberglass Reinforced Polymer Sheets: Ultraviolet (UV) protected.
   1. Tensile Strength: 23,000 psi (158.58 MPa), minimum, when tested in accordance with ASTM D638.
   2. Flexural Modulus: 1,100,000 psi (7584 MPa), minimum, when tested in accordance with ASTM D790.
   3. Light Transmittance, Clear, Transparent Sheet: 92 percent, minimum, determined in accordance with ASTM D1003.

F. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch (0.81 mm) minimum thickness; finish to match framing members.

G. Concealed Flashings: Sheet aluminum, 26 gauge, 0.017 inch (0.43 mm) minimum thickness.

H. Fasteners: Stainless steel.

2.07 FABRICATION

A. Fabricate system components with minimum clearances and shim spacing around perimeter of assembly, and ensure proper installation and dynamic movement of perimeter seals.

B. Accurately fit and secure joints and corners. Make joints flush and hairline.

C. Prepare components to receive fabricated anchor devices.

D. Locate fasteners and attachments to ensure concealment from view.

E. Reinforce framing members for external imposed loads.

2.08 FINISHES

A. Aluminum Materials:
   1. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41, clear anodic coating not less than 0.7 mils (0.018 mm) thick.
   2. Touch-Up Materials: As recommended by coating manufacturer for field application.

B. Concealed Steel Items:
   1. Galvanized in accordance with ASTM A123/A123M requirements.
   2. Primed with iron oxide paint.

C. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify wall openings and adjoining water-resistive barrier materials are ready to receive translucent wall and roof assemblies; see Section 07 25 00.

3.02 SURFACE PREPARATION

A. Where aluminum contacts dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

B. Where aluminum contacts concrete, masonry or pressure treated wood, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by manufacturer.

3.03 INSTALLATION

A. Install translucent panel system with cells vertical in accordance with manufacturer instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances and align with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings.

G. Coordinate installation of air stop at edge of construction.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Install cellular translucent wall systems in accordance with manufacturer instructions.

3.04 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm/m) non-cumulative or 1/2 inch per 100 feet (12.7 mm/30 m), whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

C. Sealant Space Between Panel System Members and Adjacent Construction: Maximum of 3/4 inch (19 mm) and minimum of 1/4 inch (6.4 mm).

3.05 FIELD QUALITY CONTROL

A. Provide the services of the manufacturer's field representative to observe installation and make report.

B. Inspection will monitor quality of installation and glazing.

C. Test installed wall assemblies for water leakage in accordance with AAMA 501.2.

D. Replace wall components that have failed field testing and retest until performance is satisfactory.

3.06 CLEANING

A. Remove protective material from prefinished aluminum surfaces.

B. Wash down interior and exterior surfaces with solution of mild detergent in warm water, applied with soft, clean wiping cloths; remove dirt from corners and wipe surfaces clean.

3.07 PROTECTION

A. Protect finished work from damage until Date of Substantial Completion.

END OF SECTION 08 45 00

SECTION 08 71 00
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for wood and hollow metal doors.
B. Hardware for fire-rated doors.
C. Electrically operated and controlled hardware.
D. Lock cylinders for doors that hardware is specified in other sections.
E. Thresholds.
F. Weatherstripping and gasketing.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealants for setting exterior door thresholds.
B. Section 08 11 13 - Hollow Metal Doors and Frames.
C. Section 08 14 16 - Flush Wood Doors.
D. Section 08 33 23 - Overhead Coiling Doors: Door hardware, including cylinders.
E. Section 08 36 13 - Sectional Doors: Door hardware, including cylinders.
F. Section 08 43 13 - Aluminum-Framed Storefronts: Door hardware, except as noted in section.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
B. BHMA (CPD) - Certified Products Directory Current Edition.
C. BHMA A156.1 - Standard for Butts and Hinges 2021.
D. BHMA A156.2 - Bored and Preassembled Locks and Latches 2022.
E. BHMA A156.3 - Exit Devices 2020.
F. BHMA A156.4 - Door Controls - Closers 2019.
G. BHMA A156.5 - Cylinders and Input Devices for Locks 2020.
H. BHMA A156.6 - Standard for Architectural Door Trim 2021.
I. BHMA A156.7 - Template Hinge Dimensions 2016.
J. BHMA A156.8 - Door Controls - Overhead Stops and Holders 2021.
K. BHMA A156.13 - Mortise Locks & Latches Series 1000 2022.
L. BHMA A156.15 - Release Devices - Closer Holder, Electromagnetic and Electromechanical 2021.
M. BHMA A156.16 - Auxiliary Hardware 2018.
N. BHMA A156.17 - Self Closing Hinges & Pivots 2019.
O. BHMA A156.20 - Standard for Strap and Tee Hinges, and Hasps 2021.
P. BHMA A156.21 - Thresholds 2019.
Q. BHMA A156.22 - Standard for Gasketing 2021.
R. BHMA A156.25 - Electrified Locking Devices 2023.
S. BHMA A156.26 - Standard for Continuous Hinges 2021.
T. BHMA A156.31 - Electric Strikes and Frame Mounted Actuators 2019.
U. BHMA A156.36 - Auxiliary Locks 2020.
V. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames 2016.
W. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames 2006.
X. DHI (H&S) - Sequence and Format for the Hardware Schedule 2019.

Y. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors 1993; also in WDHS-1/WDHS-5 Series, 1996.

Z. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

AA. ITS (DIR) - Directory of Listed Products Current Edition.

BB. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

CC. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.

DD. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

EE. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2022.

FF. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2022.

GG. UL (DIR) - Online Certifications Directory Current Edition.

HH. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

II. UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by affected installers and the following:
   1. Contracting Agency.
   2. Installer's Architectural Hardware Consultant (AHC).
   3. Hardware Installer.
   4. Contracting Agency's Security Consultant.

D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

E. Keying Requirements Meeting:
   1. Schedule meeting at project site prior to Contractor occupancy.
   2. Attendance Required:
      a. Contractor.
      b. Contracting Agency.
      c. Installer's Architectural Hardware Consultant (AHC).
      d. Hardware Installer.
      e. Contracting Agency's Security Consultant.
   3. Agenda:
      a. Establish keying requirements.
      b. Verify locksets and locking hardware are functionally correct for project requirements.
      c. Verify that keying and programming complies with project requirements.
      d. Establish keying submittal schedule and update requirements.
   4. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
      a. Access control requirements.
      b. Key control system requirements.
      c. Schematic diagram of preliminary key system.
      d. Flow of traffic and extent of security required.
   5. Record minutes and distribute copies within two days after meeting to participants, with copies to Contracting Agency, Contracting Agency, participants, and those affected by decisions made.

6. Deliver established keying requirements to manufacturers.

1.05 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
   1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
   2. Comply with DHI (H&S) using door numbers and hardware set numbers as indicated in construction documents.
   3. List groups and suffixes in proper sequence.
   4. Provide complete description for each door listed.
   5. Provide manufacturer name, product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
   6. Include account of abbreviations and symbols used in schedule.

D. Shop Drawings - Electrified Door Hardware: Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
   1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
   2. Elevations: Submit front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
   3. Diagrams: Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.

E. Samples for Verification:
   1. Submit minimum size of 2 by 4 inch (51 by 102 mm) for sheet samples, and minimum length of 4 inch (102 mm) for other products.
   2. Submit one (1) sample of hinge, latchset, lockset, and closer illustrating style, color, and finish.
   3. Return full-size samples to Contractor.
   4. Submit product description with samples.

F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

G. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
   1. Submit manufacturer's parts lists and templates.
   2. Bitting List: List of combinations as furnished.

H. Keying Schedule:
   1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

I. Manufacturer's qualification statement.

J. Installer's qualification statement.

K. Supplier's qualification statement.

L. Specimen warranty.

M. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

N. Maintenance Materials and Tools: Furnish the following for Contracting Agency's use in maintenance of project.
   1. See Section 1-06.9 for additional maintenance materials and provisions.

2. Lock Cylinders: Ten for each master keyed group.
3. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.06 QUALITY ASSURANCE

A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Contracting Agency and Contractor.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum ten years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.

D. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) to assist in work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.08 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Manufacturer's Warranty: Provide warranty against defects in material and workmanship for period indicated. Complete forms in Contracting Agency's name and register with manufacturer.
1. Closers: Ten years, minimum.
2. Exit Devices: Three years, minimum.
3. Locksets and Cylinders: Three years, minimum.
4. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:
1. Applicable provisions of federal, state, and local codes.
2. Accessibility: ADA Standards and ICC A117.1.
3. Applicable provisions of NFPA 101.
4. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
5. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.
6. Hardware for Smoke and Draft Control Doors (Indicated as "S" on Drawings): Provide door hardware that complies with local codes, and requirements of assemblies tested in accordance with UL 1784.
    a. Air Leakage Rate: Tested in accordance with UL 1784, with air leakage rate not to exceed 3.0 cfm/sf (0.01524 cu m/sec/sq m) of door opening at 0.10 inch (24.9 Pa) of water for both ambient and elevated temperature tests.
7. Listed and certified compliant with specified standards by BHMA (CPD).
8. Auxiliary Hardware: BHMA A156.16.
9. Straps and Tee Hinges: BHMA A156.20.
10. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
11. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.
12. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.

D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.

E. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. Refer to Door Hardware Schedule.

F. Fasteners:
   1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
      a. Aluminum fasteners are not permitted.
      b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
   2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
      a. Self-drilling (Tek) type screws are not permitted.
   3. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.
   4. Provide wall grip inserts for hollow wall construction.
   5. Provide spacers or sex bolts with sleeves for through bolting of hollow metal doors and frames.
   6. Fire-Rated Applications: Comply with NFPA 80.
      a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
      b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.
   7. Concealed Fasteners: Do not use through or sex bolt type fasteners on door panel sides indicated as concealed fastener locations, unless otherwise indicated.

2.02 HINGES

A. Manufacturers:
   1. Ives, an Allegion brand: www.allegion.com/us/#sle.
   2. McKinney; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   3. Hager Companies: www.hagerco.com/#sle.
   4. Stanley, dormakaba Group: www.stanleyhardwarefordoors.com/#sle.
   5. Substitutions: See Section 1-06.7.

B. Hinges: Comply with BHMA A156.1, Grade 1.
   1. Self Closing Hinges: Comply with BHMA A156.17.
   2. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
      a. Provide hinge width required to clear surrounding trim.
   3. Continuous Hinges: Comply with BHMA A156.26.
   4. Provide hinges on every swinging door.
   5. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
   6. Provide ball-bearing hinges at each door with closer.
   7. Provide non-removable pins on exterior outswinging doors.
   8. Provide non-removable pins on interior outswinging doors at locations as indicated in Door Hardware Schedule.
   9. Provide power transfer hinges where electrified hardware is mounted in door leaf.
   10. Provide following quantity of butt hinges for each door:
      a. Doors up to 60 inches (1.5 m) High: Two hinges.
      b. Doors From 60 inches (1.5 m) High up to 90 inches (2.3 m) High: Three hinges.
      c. Doors 90 inches (2.3 m) High up to 120 inches (3 m) High: Four hinges.

2.03 FLUSH BOLTS

A. Manufacturers:
   1. Hager Companies: www.hagerco.com/#sle.
   2. Ives, an Allegion brand: www.allegion.com/us/#sle.

3. Trimco: www.trimcohardware.com/#sle.
4. Substitutions: See Section 1-06.7.

B. Flush Bolts: Comply with BHMA A156.16, Grade 1.
1. Flush Bolt Throw: 3/4 inch (19 mm), minimum.
2. Provides extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
   a. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
3. Provide dustproof floor strike for bolt into floor, except at metal thresholds.
4. Manual Flush Bolts: Provide lever extensions for top bolt at over-sized doors.
5. Automatic Flush Bolts: Automatically latch upon closing of door; automatic retraction of bolts when active leaf is opened; located on inactive leaf of pair of doors.

2.04 EXIT DEVICES

A. Manufacturers:
1. Corbin Russwin, Sargent, or Yale; an Assa Abloy Group company: www.assaabloydss.com/#sle.
2. Falcon, an Allegion brand: www.allegion.com/us/#sle.
3. Hager Companies: www.hagerco.com/#sle.
4. Stanley, dormakaba Group: www.stanleyhardwarefordoors.com/#sle.
5. Von Duprin, an Allegion brand: www.allegion.com/us/#sle.
6. Substitutions: See Section 1-06.7.

B. Exit Devices: Comply with BHMA A156.3, Grade 1.
1. Lever design to match lockset trim.
2. Provide cylinder with cylinder dogging or locking trim.
3. Provide exit devices properly sized for door width and height.
4. Provide strike as recommended by manufacturer for application indicated.
5. Provide less bottom rod (LBR) at scheduled locations to eliminate use of floor mounted strikes.
6. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.
7. For electrical options, provide quick connect plug-in pre-wired connectors.

2.05 LOCK CYLINDERS

A. Manufacturers:
1. Schlage, an Allegion brand: www.allegion.com/us/#sle.
2. Corbin Russwin, Sargent, or Yale; an Assa Abloy Group company: www.assaabloydss.com/#sle.
3. Best, dormakaba Group: www.bestaccess.com/#sle.
4. Substitutions: See Section 1-06.7.

B. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
1. Provide standard, electronic, conventional, full size interchangeable core (FSIC), and small format interchangeable core (SFIC) type cylinders, Grade 1, with six-pin core in compliance with BHMA A156.5 at locations indicated.
2. Provide cylinders from same manufacturer as locking device.
3. Provide cams and/or tailpieces as required for locking devices.
4. Within specific Door Sections, when provisions for lock cylinder are being referenced to this Section, provide specified lock cylinder and keyed to building keying system, unless otherwise indicated.

2.06 CYLINDRICAL LOCKS

A. Manufacturers:
1. Corbin Russwin, Sargent, or Yale; an Assa Abloy Group company: www.assaabloydss.com/#sle.
2. Best, dormakaba Group: www.bestaccess.com/#sle.
3. Schlage, an Allegion brand: www.allegion.com/us/#sle.

4. Substitutions: See Section 1-06.7.

B. Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 1, 4000 Series.
   1. Bored Hole: 2-1/8 inch (54 mm) diameter.
   2. Latchbolt Throw: 1/2 inch (12.7 mm), minimum.
   3. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
   4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
      a. Finish: To match lock or latch.
   5. Provide a lock for each door, unless otherwise indicated that lock is not required.
   6. Trim: Provide lever handle or pull trim on outside of each lock, unless otherwise indicated.

2.07 MORTISE LOCKS

A. Manufacturers:
   1. Corbin Russwin, Sargent, or Yale; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Best, dormakaba Group: www.bestaccess.com/#sle.
   3. Schlage, an Allegion brand: www.allegion.com/us/#sle.
   4. Substitutions: See Section 1-06.7.

B. Mortise Locks: Comply with BHMA A156.13, Grade 1, Security, 1000 Series.
   1. Latchbolt Throw: 3/4 inch (19 mm), minimum.
   2. Deadbolt Throw: 1 inch (25.4 mm), minimum.
   3. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
   4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
      a. Finish: To match lock or latch.

2.08 ELECTROMECHANICAL LOCKS

A. Manufacturers:
   1. Sargent or Yale; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Best, dormakaba Group: www.bestaccess.com/#sle.
   3. Schlage, an Allegion brand: www.allegion.com/us/#sle.
   4. Substitutions: See Section 1-06.7.

B. Electromechanical Locks: Comply with BHMA A156.25, Grade 1.
   1. Provide motor-driven or solenoid-driven locks, with strike that is applicable to frame.
   2. Type: Mortise deadlocking latchbolt.

2.09 COORDINATORS

A. Manufacturers:
   1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. DORMA USA, Inc; TS93 GSR: www.dorma.com/#sle.
   3. Ives, an Allegion brand: www.allegion.com/us/#sle.
   4. Trimco: www.trimcohardware.com/#sle.
   5. Substitutions: See Section 1-06.7.

B. Coordinators: Provide on doors having closers and self-latching or automatic flush bolts to ensure that inactive door leaf closes before active door leaf.
   1. Type: Bar, unless otherwise indicated.
   2. Material: Aluminum, unless otherwise indicated.
   3. Ensure that coordination of other door hardware affected by placement of coordinators and carry bar is applied properly for completely operable installation.

2.10 CLOSERS

A. Manufacturers; Surface Mounted:
   1. Corbin Russwin, Norton, Rixson, Sargent, or Yale; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Falcon, an Allegion brand: www.allegion.com/us/#sle.
   3. LCN, an Allegion brand: www.allegion.com/us/#sle.

4. Substitutions: See Section 1-06.7.

B. Closers: Comply with BHMA A156.4, Grade 1.
   1. Type: Surface mounted to door.
   2. Provide door closer on each exterior door.
   3. Provide door closer on each fire-rated and smoke-rated door.
      a. Spring hinges are not an acceptable self-closing device, unless otherwise indicated.
   4. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.
   5. At corridor entry doors, mount closer on room side of door.
   6. At outswinging exterior doors, mount closer on interior side of door.

2.11 OVERHEAD STOPS AND HOLDERS

A. Manufacturers:
   1. Rixson or Sargent; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. DORMA USA, Inc; 900 Series: www.dorma.com/#sle.
   3. Glynn-Johnson, an Allegion brand: www.allegion.com/us/#sle.
   4. Substitutions: See Section 1-06.7.

B. Overhead Stops and Holders (Door Checks): Comply with BHMA A156.8, Grade 1.

2.12 ARMOR PLATES

A. Manufacturers:
   1. Hiawatha, Inc, an Activar Construction Products Group company: www.activarcpg.com/hiawatha/#sle.
   2. Ives, an Allegion brand: www.allegion.com/us/#sle.
   3. Trimco: www.trimcohardware.com/#sle.
   4. Substitutions: See Section 1-06.6(2).

B. Armor Plates: Provide on bottom half of push side of doors that require protection from objects moving through openings that may damage door surface.
   1. Size: 30 inch (762 mm) high by 2 inch (51 mm) less door width (LDW) on pull side and 2 inch (51 mm) LDW on push side of door unless otherwise noted.

2.13 KICK PLATES

A. Manufacturers:
   1. Hiawatha, Inc, an Activar Construction Products Group company: www.activarcpg.com/hiawatha/#sle.
   2. Ives, an Allegion brand: www.allegion.com/us/#sle.
   3. Standard Metal Hardware Manufacturing Ltd; Door Plates: www.smhardware.com/#sle.
   4. Trimco: www.trimcohardware.com/#sle.
   5. Substitutions: See Section 1-06.7.

B. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
   1. Size: 10 inch (254 mm) high by 2 inch (51 mm) less door width (LDW) on push side of door unless noted otherwise.

2.14 WALL STOPS

A. Manufacturers:
   1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Hager Companies: www.hagerco.com/#sle.
   3. Ives, an Allegion brand: www.allegion.com/us/#sle.
   4. Trimco: www.trimcohardware.com/#sle.
   5. Substitutions: See Section 1-06.7.

B. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
   1. Provide wall stops to prevent damage to wall surface upon opening door.
   2. Type: Bumper, convex, wall stop.
   3. Material: Stainless steel housing with rubber insert.

2.15 ASTRAGALS

A. Manufacturers:
   1. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Hager Companies: www.hagerco.com/#sle.
   3. National Guard Products, Inc: www.ngpinc.com/#sle.
   4. Zero International, Inc: www.zerointernational.com/#sle.
   5. Substitutions: See Section 1-06.7.

B. Astragals: Comply with BHMA A156.22.
   1. Provide surface mounted astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
   2. Type: Security, and with horizontal adjustment option.
   3. Material: Stainless steel.
   4. Provide non-corroding fasteners at exterior locations.

2.16 THRESHOLDS

A. Manufacturers:
   1. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Hager Companies: www.hagerco.com/#sle.
   3. National Guard Products, Inc: www.ngpinc.com/#sle.
   4. Zero International, Inc: www.zerointernational.com/#sle.
   5. Substitutions: See Section 1-06.7.

B. Thresholds: Comply with BHMA A156.21.
   1. Provide threshold at each exterior door, unless otherwise indicated.
   2. Type: Flat surface.
   3. Material: Aluminum.
   4. Threshold Surface: Fluted horizontal grooves across full width.
   5. Field cut threshold to profile of frame and width of door sill for tight fit.
   6. Provide non-corroding fasteners at exterior locations.

2.17 WEATHERSTRIPPING AND GASKETING

A. Manufacturers:
   1. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Hager Companies: www.hagerco.com/#sle.
   3. National Guard Products, Inc: www.ngpinc.com/#sle.
   4. Zero International, Inc: www.zerointernational.com/#sle.
   5. Substitutions: See Section 1-06.7.

B. Weatherstripping and Gasketing: Comply with BHMA A156.22.
   1. Head and Jamb Type: Self-adhesive.
   2. Door Sweep Type: Door shoe with drip cap.
   3. Provide gasketing for smoke and draft control doors (Indicated as "S" on Drawings) that complies with local codes, requirements of assemblies tested in accordance with UL 1784.
   4. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated.
   5. Provide door bottom sweep on each exterior door, unless otherwise indicated.

2.18 PADLOCKS

A. Manufacturers:
   1. Best, dormakaba Group: www.bestaccess.com/#sle.
   2. Substitutions: See Section 1-06.7.

B. Padlocks: Solid extruded brass case with shackle that locks at heel and toe.
   1. Shackle Height: Minimum 2 inch (51 mm), and width of opening is about 7/8 inch (22.2 mm).
   2. Shackle Material: Molybdenum hardened steel.
   3. Shackle Diameter: 3/8 inch (9.5 mm).
   4. Finish: 606 - Satin Brass.

5. Keying: 7-pin SFIC (Small Format Interchangeable Core).
6. Lock Functions:

2.19 LATCH PROTECTOR

A. Manufacturers:
   1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Ives, an Allegion brand: www.allegion.com/us/#sle.
   3. Zero International, Inc: www.zerointernational.com/#sle.
   4. Substitutions: See Section 1-06.7.

B. Latch Protector: Provide on door to protect latch from being tampered with while in locked position.
   1. Type: Standard latch protector.
   2. Material: Stainless steel.

2.20 SILENCERS

A. Manufacturers:
   1. Ives, an Allegion brand: www.allegion.com/us/#sle.
   2. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   3. Substitutions: See Section 1-06.7.

B. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
   1. Single Door: Provide three on strike jamb of frame.
   2. Pair of Doors: Provide two on head of frame, one for each door at latch side.
   3. Material: Rubber, gray color.

2.21 FIRE DEPARTMENT LOCK BOX

A. Manufacturers:
   1. Knox Company; Knox-Box Rapid Entry System: www.knoxbox.com/#sle.
   2. Substitutions: See Section 1-06.7.

B. Fire Department Lock Box:
   1. Heavy-duty, surface mounted, solid stainless-steel box with hinged door and interior gasket seal; single drill resistant lock with dust covers.
   2. Capacity: Holds 2 keys at buildings and electronic access key card at gates.
   3. Locations
      a. Building: One at each building main entrance on building wall at an accessible height.
      b. Gates: One at each site gate entrance electronic access key card kiosk on support column at an accessible height.
   4. Finish: Manufacturer's standard dark bronze.

2.22 POWER SUPPLY & ACCESSORIES

A. Manufacturers:
   1. Detex Corporation: www.detex.com/#sle.
   2. Securitron; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   3. Von Duprin, an Allegion brand: www.allegion.com/us/#sle.
   4. Schlage, an Allegion brand: www.allegion.com/us/#sle.
   5. Substitutions: See Section 1-06.7.

B. Power Supply: Hard wired, UL (DIR) Class 2 listed.
   1. Operating Temperature: 32 to 110 degrees F (0 to 43 degrees C).
   2. Provide with emergency release terminals that release devices upon activation of fire alarm system.

2.23 FINISHES

A. Finishes: Identified in Door Hardware Schedule.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

B. Verify that electric power is available to power operated devices and of correct characteristics.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

C. Install hardware for smoke and draft control doors in accordance with NFPA 105.

D. Use templates provided by hardware item manufacturer.

E. Do not install surface mounted items until application of finishes to substrate are fully completed.

F. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
   1. For Steel Doors and Frames: See Section 08 11 13.
   2. For Aluminum-Framed Storefront Doors and Frames: See Section 08 43 13.
   3. For Wood Doors: Install in compliance with DHI WDHS.3 recommendations.
   4. Flush Wood Doors: See Section 08 14 16.
   5. Mounting heights in compliance with ADA Standards:
      a. Locksets: 40-5/16 inch (1024 mm).
      b. Push Plates/Pull Bars: 42 inch (1067 mm).
      c. Deadlocks (Deadbolts): 48 inch (1219 mm).
      d. Exit Devices: 40-5/16 inch (1024 mm).
      e. Door Viewer: 43 inch (1092 mm); standard height 60 inch (1524 mm).

G. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.
   1. See Section 07 92 00 for additional requirements.

3.03 FIELD QUALITY CONTROL

A. Provide an Architectural Hardware Consultant (AHC) to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified. Notify Owner/Owner Representative 24-48 hours in advance.

3.04 ADJUSTING

A. Adjust hardware for smooth operation.

B. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.05 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by hardware installation.

C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.06 PROTECTION

A. Do not permit adjacent work to damage hardware or finish.

3.07 DOOR HARDWARE SETS - SEE FOLLOWING PAGES

END OF SECTION 08 71 00

This page intentionally left blank

HW SET # 01

Openings

001

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-3547A-DT-CON 24 VDC	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-3547A-NL-CON 24 VDC	626	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
2	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	MOUNTING PLATE	4110-18 SRT	689	LCN
2	EA	CUSH SHOE SUPPORT	4110-30 SRT	689	LCN
2	EA	BLADE STOP SPACER	4110-61 SRT	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
2	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER
2	EA	WIRE HARNESS	CON-192P VERIFY LENGTH		SCH
2	EA	WIRE HARNESS	CON-6W		SCH
2	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC		VON
1			ACCESS CONTROL - WORK OF DIVISION 28		
1			PERIMETER SEALS BY FRAME MANUFACTURER		
1		WIRING DIAGRAMS	PROVIDE RISER AND POINT TO POINT DIAGRAMS		

OPERATION: CARD READER OR TIME CLOCK TO RETRACT PANIC LATCHES

HW SET # 02

Openings

002

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-CON 24 VDC	630	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	MOUNTING PLATE	4110-18 SRT	689	LCN
1	EA	CUSH SHOE SUPPORT	4110-30 SRT	689	LCN
1	EA	BLADE STOP SPACER	4110-61 SRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
3	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER
1	EA	WIRE HARNESS	CON-192P VERIFY LENGTH		SCH
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	DOOR CONTACT	679-05HM/WD AS REQ'D	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-FA 900-2RS 900-BBK 120/240 VAC		VON

OPERATION: CARD READER OR TIME CLOCK TO RETRACT PANIC LATCHES

HW SET # 03

Openings

003A

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	PASSAGE SET	L9010 03A	630	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	WALL STOP	WS406/407CVX	630	IVE
1			PERIMETER SEALS BY FRAME MANUFACTURER		

HW SET # 04

Openings

118A 134A 135A B100B

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	EU MORTISE LOCK	L9092TEU 03A RX CON 12/24 VDC	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4011 DEL	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	546A-223	A	ZER
1	EA	WIRE HARNESS	CON-192P VERIFY LENGTH		SCH
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	DOOR CONTACT	679-05HM/WD AS REQ'D	BLK	SCE
			POWER SUPPLY - WORK OF DIVISION 28		

OPERATION: CARD READER OR TIME CLOCK TO RELEASE LOCK LVER

HW SET # 05

Openings

109

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	PASSAGE SET	L9010 03A	630	SCH
1	EA	SURFACE CLOSER	4011 DEL	689	LCN
1	EA	ARMOR PLATE	8400 30" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	GASKETING	488SBK PSA	BK	ZER

HW SET # 06

Openings

116A

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	AUTO FLUSH BOLT	FB41P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	EU MORTISE LOCK	L9092TEU 03A RX CON 12/24 VDC	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	ASTRAGAL	43SP	SP	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER
1	EA	WIRE HARNESS	CON-192P VERIFY LENGTH		SCH
1	EA	WIRE HARNESS	CON-6W		SCH
2	EA	DOOR CONTACT	679-05HM/WD AS REQ'D	BLK	SCE
			POWER SUPPLY - WORK OF DIVISION 28		
			ACCESS CONTROL - WORK OF DIVISION 28		

OPERATION: CARD READER OR TIME CLOCK TO RELEASE LOCK LVER

HW SET # 08

Openings

105	106	107	110	111	113
122	123	137	138	B103	B104
B105	B106	B117			

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	PRIVACY W/INDICATOR	L9056T 17A L583-363 L283-722	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	GASKETING	488SBK PSA	BK	ZER

HW SET # 09

Openings

112

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
2	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	ASTRAGAL	43SP	SP	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER
2	EA	DOOR CONTACT	679-05HM/WD AS REQ'D	BLK	SCE

HW SET # 10

Openings

B115

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	L9080T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	GASKETING	488SBK PSA	BK	ZER

HW SET # 12

Openings

119A 124 128 129 B112

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR BOTTOM	360AA	AA	ZER

HW SET # 13

Openings

118B 120D 139B 139C 140B 141B
B107A B107B B107C B108B B200 T1
T2

Each door or doors to have:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR

ALL HARDWARE BY DOOR SUPPLIER

HW SET # 14

Openings

118D 120B 201

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	AUTO FLUSH BOLT	FB41P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4011 DEL H	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	ASTRAGAL	43SP	SP	ZER
2	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	546A-223	A	ZER

HW SET # 16

Openings

125 B114

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	PANIC HARDWARE	LD-98-NL	630	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
3	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM/WD AS REQ'D	BLK	SCE

HW SET # 18

Openings

127A

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	AUTO FLUSH BOLT	FB41P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	CLASSROOM LOCK	L9070T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	OH STOP & HOLDER	90H	630	GLY
2	EA	SURFACE CLOSER	4011T HSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
3	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	ASTRAGAL	43SP	SP	ZER

HW SET # 20

Openings

B116A
Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	CLASSROOM LOCK	L9070T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4011 DEL	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

HW SET # 21

Openings

108 B102B
Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	L9080T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET # 22

Openings

120C	121	130A	130C	139A	139D
B107D	B107E	B108C			

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	EU MORTISE LOCK	L9092TEU 03A RX CON 12/24 VDC	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	LOCK GUARD	LG10	630	IVE
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
3	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER
1	EA	WIRE HARNESS	CON-192P VERIFY LENGTH		SCH
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	DOOR CONTACT	679-05HM/WD AS REQ'D	BLK	SCE
			POWER SUPPLY - WORK OF DIVISION 28		

OPERATION: CARD READER OR TIME CLOCK TO RELEASE LOCK LVER

HW SET # 23

Openings

130B	130D	131A	131B	132A	132B
133A	133B	134B	135B	B111A	B111B

Each door or doors to have:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR

ALL HARDWARE BY DOOR SUPPLIER

HW SET # 24

Openings

140A
Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	CLASSROOM LOCK	L9070T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4011 DEL	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	546A-223	A	ZER

HW SET # 25

Openings

B109
Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	L9080T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	LOCK GUARD	LG10	630	IVE
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
3	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM/WD AS REQ'D	BLK	SCE

HW SET # 26

Openings

141A B108A

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	AUTO FLUSH BOLT	FB41P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4111 SHCUSH WMS	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	ASTRAGAL	43SP	SP	ZER
2	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	546A-223	A	ZER

HW SET # 27

Openings

127B B100A

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-CON 24 VDC	630	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	MOUNTING PLATE	4110-18 SRT	689	LCN
1	EA	CUSH SHOE SUPPORT	4110-30 SRT	689	LCN
1	EA	BLADE STOP SPACER	4110-61 SRT	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER
1	EA	WIRE HARNESS	CON-192P VERIFY LENGTH		SCH
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	DOOR CONTACT	679-05HM/WD AS REQ'D	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC		VON
1			ACCESS CONTROL - WORK OF DIVISION 28		
1		WIRING DIAGRAMS	PROVIDE RISER AND POINT TO POINT DIAGRAMS		
1			PROVIDE RISER DIAGRAMS		
1			WEATHERSTRIP BY DOOR/FRAME MANUFACTURER		

OPERATION: CARD READER OR TIME CLOCK TO RETRACT PANIC LATCHES

HW SET # 28

Openings

116B 202 B102A

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	L9080T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
3	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	546A-223	A	ZER

HW SET # 31

Openings

B201

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	PANIC HARDWARE	LD-98-NL	630	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
3	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR CONTACT	679-05HM/WD AS REQ'D	BLK	SCE

HW SET # 32

Openings

114 B113

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	L9080T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4011 DEL	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	GASKETING	488SBK PSA	BK	ZER

HW SET # 33

Openings

118C 120A W1 W2

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	L9080T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4011 DEL	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	546A-223	A	ZER

HW SET # 34

Openings

136B

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	EU MORTISE LOCK	L9092TEU 03A RX CON 12/24 VDC	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	LOCK GUARD	LG10	630	IVE
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	MOUNTING PLATE	4110-18 SRT	689	LCN
1	EA	CUSH SHOE SUPPORT	4110-30 SRT	689	LCN
1	EA	BLADE STOP SPACER	4110-61 SRT	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER
1	EA	WIRE HARNESS	CON-192P VERIFY LENGTH		SCH
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	DOOR CONTACT	679-05HM/WD AS REQ'D	BLK	SCE
			POWER SUPPLY - WORK OF DIVISION 28		
1			PERIMETER SEALS BY FRAME MANUFACTURER		

OPERATION: CARD READER OR TIME CLOCK TO RELEASE LOCK LVER

HW SET # 35

Openings

B101B
Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-3547A-DT-CON 24 VDC	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-3547A-NL 24 VDC	626	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
1	EA	MORTISE CYLINDER	20-061 ICX 36-083	626	SCH
2	EA	FSIC CORE	23-030 EV D	626	SCH
2	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	MOUNTING PLATE	4110-18 SRT	689	LCN
1	EA	CUSH SHOE SUPPORT	4110-30 SRT	689	LCN
1	EA	BLADE STOP SPACER	4110-61 SRT	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
2	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER
2	EA	WIRE HARNESS	CON-192P VERIFY LENGTH		SCH
2	EA	WIRE HARNESS	CON-6W		SCH
2	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC		VON
1			ACCESS CONTROL - WORK OF DIVISION 28		
1			PERIMETER SEALS BY FRAME MANUFACTURER		
1		WIRING DIAGRAMS	PROVIDE RISER AND POINT TO POINT DIAGRAMS		

OPERATION: CARD READER OR TIME CLOCK TO RETRACT PANIC LATCHES
CLOSERS REQUIRE 6" TOP RAIL.

HW SET # 36

Openings

B116B
Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	EU MORTISE LOCK	L9092TEU 03A RX CON 12/24 VDC	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4011T HBMP HSRT	689	LCN
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER
1	EA	WIRE HARNESS	CON-192P VERIFY LENGTH		SCH
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	DOOR CONTACT	679-05HM/WD AS REQ'D	BLK	SCE
			POWER SUPPLY - WORK OF DIVISION 28		
1			PERIMETER SEALS BY FRAME MANUFACTURER		

OPERATION: CARD READER OR TIME CLOCK TO RELEASE LOCK LVER

HW SET # 37

Openings

B202
Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	AUTO FLUSH BOLT	FB41P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4111 SCUSH WMS	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	ASTRAGAL	43SP	SP	ZER

HW SET # 38

Openings

003B

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	PASSAGE SET	L9010 03A	630	SCH
1	EA	SURFACE CLOSER	4011 DEL	689	LCN
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	546A-223	A	ZER
1			PERIMETER SEALS BY FRAME MANUFACTURER		

HW SET # 39

Openings

101A B101A

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	PASSAGE SET	L9010 03A	630	SCH
1	EA	SURFACE CLOSER	4011 DEL	689	LCN
1	EA	WALL STOP	WS406/407CVX	630	IVE
1			PERIMETER SEALS BY FRAME MANUFACTURER		

HW SET # 40

Openings

101B

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	AUTO FLUSH BOLT	FB41P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	EU MORTISE LOCK	L9092TEU 03A RX CON 12/24 VDC	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	MOUNTING PLATE	4110-18 SRT	689	LCN
1	EA	CUSH SHOE SUPPORT	4110-30 SRT	689	LCN
1	EA	BLADE STOP SPACER	4110-61 SRT	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	ASTRAGAL	43SP	SP	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER
1	EA	WIRE HARNESS	CON-192P VERIFY LENGTH		SCH
1	EA	WIRE HARNESS	CON-6W		SCH
2	EA	DOOR CONTACT	679-05HM/WD AS REQ'D	BLK	SCE
			POWER SUPPLY - WORK OF DIVISION 28		
			ACCESS CONTROL - WORK OF DIVISION 28		
1			PERIMETER SEALS BY FRAME MANUFACTURER		

OPERATION: CARD READER OR TIME CLOCK TO RELEASE LOCK LVER

HW SET # 41

Openings

117A 119B

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	DOOR BOTTOM	360AA	AA	ZER
1			PERIMETER SEALS BY FRAME MANUFACTURER		

HW SET # 42

Openings

102 136A 136C ST1

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	PASSAGE SET	L9010 03A	630	SCH
1	EA	SURFACE CLOSER	4011 DEL	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	546A-223	A	ZER

HW SET # 43

Openings

126

Each door or doors to have:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080T 03A	630	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS B4E X .50	630	IVE
2	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	ASTRAGAL	43SP	SP	ZER

HW SET # 44

Openings

200

Each door or doors to have:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR

ALL HARDWARE BY GATE MFG

SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Glazing compounds.

1.02 RELATED REQUIREMENTS

A. Section 07 25 00 - Weather Barriers.

B. Section 07 92 00 - Joint Sealants: Sealants for other than glazing purposes.

C. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.

D. Section 08 36 13 - Sectional Doors: Glazed lites in doors.

E. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.

F. Section 08 45 00 - Translucent Wall and Roof Assemblies.

G. Section 10 28 00 - Toilet, Bath, Laundry and Cleaning Accessories: Mirrors.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers 2005 (Reapproved 2019).

C. ASTM C1036 - Standard Specification for Flat Glass 2021.

D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.

E. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.

F. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass 2021a.

G. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings 2016.

H. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation 2019.

I. GANA (GM) - GANA Glazing Manual 2022.

J. GANA (SM) - GANA Sealant Manual 2008.

K. GANA (LGRM) - Laminated Glazing Reference Manual 2019.

L. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use 1990 (2016).

M. NFRC 100 - Procedure for Determining Fenestration Product U-factors 2020.

N. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence 2020.

O. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Samples: Submit two samples 5 by 5 inch (127 by 127 mm) in size of glass units.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Contracting Agency's name and registered with manufacturer.

H. Maintenance Materials: Furnish the following for Contracting Agency's use in maintenance of project.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
      a. Insulating Glass Certification Council (IGCC).
      b. Safety Glazing Certification Council (SGCC).

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.
   1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
      a. North American Contractor Certification (NACC) for glazing contractors.
      b. Equivalent independent third-party ANSI accredited certification.

D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.07 MOCK-UPS

A. See Section 1-06.8 for additional mock-up requirements.

B. Provide mock-up of exterior glazing, each type including glass and weather barrier at head, jamb and sill of each type.

C. Provide on-site glazing mock-up with the specified glazing components.

D. Mock-ups may remain as part of the Work.

1.08 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.09 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

C. Heat Soaked Tempered Glass: Provide a five (5) year manufacturer warranty to include coverage for spontaneous breakage of fully tempered glass caused by nickel sulfide (NiS) inclusions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Glass Fabricators:
   1. GGI - General Glass International: www.generalglass.com/#sle.
   2. Standard Bent Glass Corp: www.standardbent.com/#sle.
   3. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com/#sle.
   4. Viracon, Inc: www.viracon.com/#sle.
   5. Substitutions: See Section 1-06.7.

B. Float Glass Manufacturers:
   1. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
   2. Guardian Glass, LLC: www.guardianglass.com/#sle.
   3. Pilkington North America Inc: www.pilkington.com/na/#sle.
   4. Saint Gobain North America: www.saint-gobain.com/#sle.
   5. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
   6. Substitutions: See Section 1-06.7.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Seismic Loads: Design and size glazing components to withstand seismic loads and sway displacement in accordance with the requirements of ASCE 7
   4. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   5. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
   1. In conjunction with weather barrier related materials described in other sections, as follows:
      a. Water-Resistive Barriers: See Section 07 25 00.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

2.03 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
   3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   4. Heat-Soak Testing (HST): Provide HST of fully tempered glass used on canopy or other demanding applications of project, to reduce risks of spontaneous breakage due to nickel sulfide (NiS) induced fractures in accordance with industry established testing requirements.

2.04 INSULATING GLASS UNITS

A. Manufacturers:
   1. Cardinal Glass Industries: www.cardinalcorp.com/#sle.

2. Guardian Glass, LLC: www.guardianglass.com/#sle.
3. Pilkington North America Inc: www.pilkington.com/na/#sle.Pilkington North America Inc: www.pilkington.com/na/#sle.
4. Viracon, Apogee Enterprises, Inc: www.viracon.com/#sle.
5. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
6. Substitutions: See Section 1-06.7.

B. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

C. Insulating Glass Units: Types as indicated.
1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
3. Metal-Edge Spacers: Aluminum, bent and soldered corners.
4. Spacer Color: Aluminum.
5. Edge Seal:
   a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
   b. Color: Gray.
6. Purge interpane space with dry air, hermetically sealed.

D. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
2. Space between lites filled with argon and krypton mix..
3. Outboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
   a. Tint: Clear.
   b. Coating: Low-E (passive type), on #2 surface.
4. Inboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
   a. Tint: Clear.
5. Total Thickness: 1 inch (25.4 mm).
6. Thermal Transmittance (U-Value), See Drawings.
7. Visible Light Transmittance (VLT): 70 percent, nominal.
8. Shading Coefficient: See drawings.
9. Solar Heat Gain Coefficient (SHGC): See drawings.

2.05 GLAZING UNITS

A. Type G-1 - Monolithic Interior Vision Glazing:
1. Applications: Interior glazing unless otherwise indicated.
2. Glass Type: Fully tempered and annealed float glass.
3. Tint: Clear.
4. Thickness: 1/4 inch (6.4 mm), nominal.

2.06 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Continuous by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
1. Width: As required for application.
2. Thickness: As required for application.

3. Spacer Rod Diameter: As required for application.
4. Manufacturers:
    a. Pecora Corporation: www.pecora.com/#sle.
    b. Tremco Global Sealants: www.tremcosealants.com/#sle.
    c. Substitutions: See Section 1-06.7.

D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.05 PROTECTION

A. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION 08 80 00

SECTION 08 91 00
Llouvers

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Louvers, frames, and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 25 00 - Weather Barriers: Sealing frames to water-resistive barrier installed on adjacent construction.

B. Section 07 62 00 - Sheet Metal Flashing and Trim.

C. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.

D. Section 09 90 00 - Painting and Coating

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.

B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2012, with Editorial Revision (2015).

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2023.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.

C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, and tolerances; head, jamb and sill details; blade configuration, screens, blank-off areas required, and frames.

D. Samples: Submit two samples 2 by 2 inches (50 by 50 mm) in size illustrating finish and color of exterior surfaces.

E. Test Reports: Independent agency reports showing compliance with specified performance criteria.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

G. Maintenance Data: Include lubrication schedules, adjustment requirements.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

1.06 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Louvers:
   1. Airline Louvers: www.airlinelouvers.com/#sle.
   2. Airolite Company, LLC: www.airolite.com/#sle.

3. Construction Specialties, Inc; Explosion Relief Louver, Model ERL: www.c-sgroup.com/#sle.
4. Industrial Louvers, Inc: www.industriallouvers.com/#sle.
5. NCA, a brand of Metal Industries Inc: www.ncamfg.com/#sle.
6. Ruskin: www.ruskin.com/#sle.
7. Substitutions: See Section 1-06.7.

2.02 LOUVERS

A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.
   1. Wind Load Resistance: Design to resist positive and negative wind load of 25 psf (of 1.2 kPa) without damage or permanent deformation.
   2. Intake Louvers: Design to allow maximum of 0.01 oz/sq ft (3.1 g/sq m) water penetration at calculated intake design velocity based on design air flow and actual free area, when tested in accordance with AMCA 500-L.
   3. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
   4. Screens: Provide insect screens at intake louvers and bird screens at exhaust louvers.

B. Stationary Louvers: Horizontal blade, formed galvanized steel sheet construction, with intermediate mullions matching frame.
   1. Free Area: 50 percent, minimum.
   2. Blades: Straight.
   3. Frame: 4 inches deep (100 mm deep), channel profile; corner joints mitered and , with continuous recessed caulking channel each side.
   4. Steel Thickness, Galvanized: Frame 16 gauge, 0.0598 inch (1.52 mm) minimum base metal; blades 16 gauge, 0.0598 inch (1.52 mm) minimum base metal.
   5. Steel Finish: Superior performing organic coating, finished after fabrication.

2.03 MATERIALS

A. Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

B. Stainless Steel: ASTM A666, Type 304, soft temper, smooth surface, No. 4 brushed finish.

2.04 FINISHES

A. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch (0.030 mm).
   1. Manufacturers:
      a. PPG; Duranar: www.ppgmetalcoatings.com/#sle.
      b. Sherwin-Williams Company; Fluropon: www.coil.sherwin.com/#sle.
      c. Substitutions: See Section 1-06.7.

2.05 ACCESSORIES

A. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.

B. Insect Screen: 18 x 16 size aluminum mesh.

C. Fasteners and Anchors: Galvanized steel.

D. Head and Sill Flashings: See Section 07 62 00.

E. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.

B. Verify that field measurements are as indicated.

3.02 INSTALLATION

A. Install louver assembly in accordance with manufacturer's instructions.

B. Install louvers level and plumb.

C. Set sill members and sill flashing in continuous bead of sealant.

D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

E. Secure louver frames in openings with concealed fasteners.

F. Coordinate with installation of mechanical ductwork.

3.03 CLEANING

A. Strip protective finish coverings.

B. Clean surfaces and components.

END OF SECTION 08 91 00

This page intentionally left blank

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Gypsum sheathing.

E. Gypsum wallboard.

F. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

B. Section 07 21 00 - Thermal Insulation: Acoustic insulation.

C. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.

D. Section 07 84 00 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.

E. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members 2016, with Supplement (2020).

B. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing 2020.

C. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing 2015, with Errata (2020).

D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.

E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

G. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members 2015.

H. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories 2020.

I. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017 (Reapproved 2022).

J. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing 2003 (Reapproved 2017).

K. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.

L. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.

M. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness 2022.

N. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2022.

O. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.

P. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2017.

Q. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel 2018.

R. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing 2018.

S. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.

T. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels 2019, with Editorial Revision (2020).

U. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2021.

V. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).

W. GA-216 - Application and Finishing of Gypsum Panel Products 2021.

X. GA-600 - Fire Resistance and Sound Control Design Manual 2021.

Y. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Z. UL (FRD) - Fire Resistance Directory Current Edition.

1.04 SUBMITTALS

A. See Section 1-04.3(7) & 1-06.1 for submittal requirements.

B. Product Data:
   1. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

C. Test Reports: For stud framing products that do not comply with AISI S220 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

D. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least seven years of documented experience.

B. Documents at Project Site: Maintain at the project site a copy of manufacturer's instructions, erection drawings, and shop drawings.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

B. Store metal products to prevent corrosion.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions in accordance with ASCE 7 for Seismic Design Category D, E, or F and complying with the following:
   1. Local authorities having jurisdiction.

C. Fire-Resistance-Rated Assemblies: Provide completed assemblies complying with applicable code.
   1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.

2. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
3. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

B. Manufacturers - Metal Framing, Connectors, and Accessories:
1. ClarkDietrich: www.clarkdietrich.com/#sle.
2. SCAFCO Corporation: www.scafco.com/#sle.
3. Steel Construction Systems: www.steelconsystems.com/#sle.
4. Substitutions: See Section 1-06.7.

C. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
1. Studs: C-shaped with knurled or embossed faces.
2. Runners: U shaped, sized to match studs.
3. Ceiling Channels: C-shaped.
4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
5. Furring Members: U-shaped sections, minimum depth of 3/4 inch (19 mm).
6. Furring Members: Zee-shaped sections, minimum depth of 1 inch (25 mm).
7. Resilient Furring Channels: Single or double leg configuration; 1/2 inch (13 mm) channel depth.

D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection and prevent rotation of studs while maintaining structural performance of partition.
1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
3. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
4. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-resistance rating of the wall assembly.
    a. Products:
        1) ClarkDietrich; BlazeFrame RipTrak: www.clarkdietrich.com/#sle.
        2) FireTrak Corporation; Posi Klip: www.fire-trak.com/#sle.
        3) MBA Building Supplies; Slotted Slip Track: www.mbastuds.com/#sle.
        4) Metal-Lite, Inc; The System: www.metal-lite.net/#sle.
        5) Substitutions: See Section 1-06.7.
5. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet (3660 mm).

E. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.

F. Preformed Top Track Firestop Seal:
1. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.

G. Non-structural Framing Accessories:
1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
    a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
    b. Height: 35-3/4 inches (908 mm).

3. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

H. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
1. American Gypsum Company: www.americangypsum.com/#sle.
2. CertainTeed Corporation: www.certainteed.com/#sle.
3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
4. National Gypsum Company: www.nationalgypsum.com/#sle.
5. PABCO Gypsum: www.pabcogypsum.com/#sle.
6. USG Corporation: www.usg.com/#sle.
7. Substitutions: See Section 1-06.7.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.

C. Backing Board For Wet Areas:
1. Application: Surfaces behind in wet areas including tub and shower surrounds and shower ceilings.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
   a. Regular Type: Thickness 1/2 inch (13 mm).
   b. Fire-Resistance-Rated Type: Type X core, thickness 5/8 inch (16 mm).
   c. Products:
      1) Georgia-Pacific Gypsum; DensShield Tile Backer: www.gpgypsum.com/#sle.
      2) Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Tile Backer: www.goldbondbuilding.com/#sle.
      3) USG Corporation; Durock Brand Glass-Mat Tile Backerboard: www.usg.com/#sle.
      4) Substitutions: See Section 1-06.7.

D. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
2. Thickness: 5/8 inch (16 mm).
3. Edges: Tapered.

E. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
1. Application: Exterior sheathing, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Fungal Resistance: No fungal growth when tested in accordance with ASTM G21.
4. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
5. Core Type: Regular and Type X, as indicated.
6. Type X Thickness: 5/8 inch (16 mm).
7. Regular Board Thickness: 5/8 inch (16 mm).
8. Edges: Square.

F. Exterior Soffit Board: Exterior gypsum soffit board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings and soffits in protected exterior areas, unless otherwise indicated.

2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X.
3. Types: Regular and Type X, in locations indicated.
4. Type X Thickness: 5/8 inch (16 mm).
5. Regular Type Thickness: 1/2 inch (13 mm).
6. Edges: Tapered.

2.04 GYPSUM BOARD ACCESSORIES

A. Acoustic Insulation: See Section 07 21 00.

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

C. Weather-Resistive Barrier: See Section 07 25 00.

D. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
1. Corner Beads: Low profile, for 90 degree outside corners.
2. L-Trim with Tear-Away Strip: Sized to fit 1/2-inch (13 mm) thick gypsum wallboard.

E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Fiberglass Tape: 2 inch (50 mm) wide, coated glass fiber tape for joints and corners.
2. Paper Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
3. Joint Compound: Drying type, vinyl-based, ready-mixed.
4. Joint Compound: Setting type, field-mixed.

F. Finishing Compound: Surface coat and primer, takes the place of skim coating.

G. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

H. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

I. Adhesive for Attachment to Wood, ASTM C557 and Metal:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
1. Level ceiling system to a tolerance of 1/1200.
2. Laterally brace entire suspension system.
3. Install bracing as required at exterior locations to resist wind uplift.
4. Extend partition framing to structure where indicated and to ceiling in other locations.
5. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
6. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

C. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

D. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches (100 mm) from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches (600 mm) on center.

1. Orientation: Vertical.
2. Spacing: As indicated.

E. Acoustic Furring: Install resilient channels at maximum 24 inches (600 mm) on center. Locate joints over framing members.

F. Furring for Fire-Resistance Ratings: Install as required for fire-resistance ratings indicated and to GA-600 requirements.

G. Blocking: Install wood blocking for support of:
1. Framed openings.
2. Wall-mounted cabinets.
3. Plumbing fixtures.
4. Toilet partitions.
5. Toilet accessories.
6. Wall-mounted door hardware.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
1. Place one bead continuously on substrate before installation of perimeter framing members.
2. Place continuous bead at perimeter of each layer of gypsum board.
3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.04 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
1. Exception: Tapered edges to receive joint treatment at right angles to framing.

C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

E. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

F. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
1. Seal joints, cut edges, and holes with water-resistant sealant.
2. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.

G. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
1. Seal joints, cut edges, and holes with water-resistant sealant.

H. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.06 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.

B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.

C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
   2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   4. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
   5. Level 0: Temporary partitions.
   6. Level 0: Surfaces indicated to be finished in later stage of project.

D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
   2. Taping, filling, and sanding are not required at surfaces behind fixed cabinetry.
   3. Taping, filling, and sanding are not required at base layer of double-layer applications.

E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.07 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

3.08 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION 09 21 16

This page intentionally left blank

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.02 RELATED REQUIREMENTS

A. Section 07 21 00 - Thermal Insulation: Acoustical insulation.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

C. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2022.

D. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels 2019.

E. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions 2022.

F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products 2022.

G. CHPS (HPPD) - High Performance Products Database Current Edition.

H. UL (GGG) - GREENGUARD Gold Certified Products Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide data on suspension system components and acoustical units.

C. Samples: Submit two samples 4 by 4 inch (152 by 152 mm) in size illustrating material and finish of acoustical units.

D. Samples: Submit two samples each, 6 inches (152 mm) long, of suspension system main runner, cross runner, and perimeter molding.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

F. Maintenance Materials: Furnish the following for Contracting Agency's use in maintenance of project.
   1. See Section 1-06.9 for additional maintenance materials and provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.06 QUALITY ASSURANCE

A. Designer Qualifications for Seismic Design: Perform under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.

B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience.

C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience.

1.07 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
   2. Acoustic Ceiling Products, Inc: www.acpideas.com/#sle.
   3. CertainTeed Corporation: www.certainteed.com/#sle.
   4. USG Corporation: www.usg.com/ceilings/#sle.
   5. Substitutions: See Section 1-06.7.

B. Suspension Systems:
   1. Same as for acoustical units.

2.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7 for Seismic Design Category D, E, or F and complying with the following:
   1. Local authorities having jurisdiction.

2.03 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.
   1. VOC Content: Certified as Low Emission by one of the following:
      a. Product listing in UL (GGG).
      b. Product listing in CHPS (HPPD).

B. Acoustical Panels: Painted mineral fiber, with the following characteristics:
   1. Classification: ASTM E1264.
   2. Size: 24 by 24 inches (610 by 610 mm).
   3. Thickness: 5/8 inch (16 mm).
   4. Panel Edge: Angled tegular.
   5. Color: White.
   6. Suspension System: Exposed grid.
   7. Basis of Design Product:
      a. Armstrong World Industries, Inc; Fine Fissured: www.armstrongceilings.com/#sle.

2.04 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.

B. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
   1. Materials:
      a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

C. Exposed Suspension System: Hot-dipped galvanized steel grid with steel cap.
   1. Application(s): Seismic.
   2. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
   3. Profile: Tee; 15/16 inch (24 mm) face width.
   4. Finish: Baked enamel.
   5. Color: White.

2.05 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.

C. Hold-Down Clips: Manufacturer's standard clips to suit application.

D. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.

E. Perimeter Moldings: Same metal and finish as grid.

F. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.03 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to reflected plan.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Overlap and rivet corners.

E. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch (19 mm) clearance between grid ends and wall.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

3.04 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.

3. Double cut and field paint exposed reveal edges.

3.05 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.06 CLEANING

A. Clean surfaces.

B. Replace damaged or abraded components.

END OF SECTION 09 51 00

SECTION 09 65 00
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient base.

B. Installation accessories.

1.02 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.

B. ASTM F1861 - Standard Specification for Resilient Wall Base 2021.

C. SCAQMD 1113 - Architectural Coatings 1977, with Amendment (2016).

1.03 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Verification Samples: Submit two samples, illustrating color and pattern for each resilient flooring product specified.

D. Sustainable Design Submittal: Submit VOC content documentation for flooring and adhesives.

E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

F. Maintenance Materials: Furnish the following for Contracting Agency's use in maintenance of project.
   1. See Section 1-06.9 for additional maintenance materials and provisions.
   2. Extra Wall Base: 50 linear feet (4.7 linear meters) of each type and color.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum 10 years documented experience.

B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store all materials off of the floor in an acclimatized, weather-tight space.

C. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).

D. Protect roll materials from damage by storing on end.

E. Do not double stack pallets.

1.06 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

PART 2 PRODUCTS

2.01 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; style as scheduled.
   1. Manufacturers:
      a. Johnsonite, a Tarkett Company: www.johnsonite.com/#sle.
      b. Mannington Commercial: www.manningtoncommercial.com#sle.

c. Roppe Corporation: www.roppe.com/#sle.
d. Substitutions: See Section 1-06.7.

2. Height: 4 inches (100 mm).
3. Thickness: 0.125 inch (3.2 mm).
4. Finish: Satin.

B. Volatile Organic Compound (VOC) Content:

1. Provide adhesives that comply with the most stringent requirements specified in the following:
   a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
   b. SCAQMD 1113 Rule.
   c. Architectural coatings VOC limits of State in which the project is located.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site, or other method acceptable to authorities having jurisdiction.

2.02 ACCESSORIES

A. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

3.02 PREPARATION

A. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

B. Prohibit traffic until filler is fully cured.

C. Clean substrate.

D. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of conditions.

B. Install in accordance with manufacturer's written instructions.

C. Adhesive-Applied Installation:

1. Spread only enough adhesive to permit installation of materials before initial set.

3.04 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.

B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.05 CLEANING

A. Remove excess adhesive from base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

END OF SECTION 09 65 00

SECTION 09 67 00
FLUID-APPLIED FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fluid-applied flooring and base.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealing joints between fluid-applied flooring and adjacent construction and fixtures.

1.03 REFERENCE STANDARDS

A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2022.

B. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride 2022.

C. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes 2019a.

D. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair 2013.

E. SCAQMD 1113 - Architectural Coatings 1977, with Amendment (2016).

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.

C. Samples: Submit two samples, 4 by 4 inch (102 by 102 mm) in size illustrating color and pattern for each floor material for each color specified.

D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and application rate for each coat.

F. Certification: By manufacturer that coatings comply with VOC limits specified.

G. Applicator's Qualification Statement.

H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

I. Maintenance Materials: Furnish the following for Contracting Agency's use in maintenance of project.
   1. See Section 1-06.9 for additional maintenance materials and provisions.
   2. Extra Top Coat Materials: 2 gallons (8 liters) each finish/color.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum seven years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section.
   1. Minimum five years of documented experience.
   2. Approved by manufacturer.

C. Supervisor Qualifications: Trained by product manufacturer , under direct full time supervision of manufacturer's own foreman.

1.06 MOCK-UPS

A. See Section 1-06.8 for additional mock-up requirements.

B. Construct mock-up(s) of fluid applied flooring including coved base to serve as basis for evaluation of texture and workmanship.

1. Number of Mock-Ups to be Prepared: One per color/finish.
2. Use same materials and methods for use in the work.
3. Use approved design samples as basis for mock-ups.
4. Locate where directed.
5. Minimum Size: 48 inches by 48 inches (1220 mm by 1220 mm).

C. Perform below Part 3 testing prior to mock-up approval.

D. Obtain approval of mock-up before proceeding with work.

E. Approved mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store resin materials in a dry, secure area.

B. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.08 FIELD CONDITIONS

A. Maintain minimum temperature in storage area of 55 degrees F (13 degrees C).

B. Store materials in area of installation for minimum period of 24 hours prior to installation.

C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fluid-Applied Flooring - Basis of Design Manufacturer and Products: Dur-A-Flex: www.dur-a-flex.com/#slee

B. Fluid-Applied Flooring: Manufacturers
1. Crossfield Products Corp: www.crossfieldproducts.com/#sle.
2. Elite Crete Systems: www.elitecrete.com/#sle.
3. Dur-A-Flex; www.dur-a-flex.com/#sle
4. Sika Corporation: www.sikafloorusa.com/#sle.
5. Terrazzo & Marble Supply Companies: www.tmsupply.com/#sle.
6. Substitutions: See Section 1-06.7.

2.02 FLUID-APPLIED FLOORING SYSTEMS

A. Volatile Organic Compound (VOC) Content:
1. Provide coatings and finishes that comply with the most stringent requirements specified in the following:
   a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
   b. SCAQMD 1113 Rule.
   c. Architectural coatings VOC limits of State in which the project is located.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site, or other method acceptable to authorities having jurisdiction.

B. Fluid-Applied Flooring Type EPX-01: Epoxy base coat(s), with sand aggregate.
1. Topcoat: Urethane.
2. System Thickness: 1/4 inch (6.35 mm), nominal, dry film thickness (DFT).
3. Texture: Slip resistant.
4. Sheen: Satin.
5. Color: Slate Grey.
6. Basis of Design Product: Dur-A-Flex; Dura-A-Crete: www.dur-a-flex.com/#slee

C. Fluid-Applied Flooring Type EPX-02: Epoxy base coat(s), with broadcast aggregate.
1. Aggregate: Quartz broadcasts.
2. Topcoat: Urethane.
3. System Thickness: 3/16 inch (4.76 mm), nominal, dry film thickness (DFT).

4. Texture: Slip resistant.
5. Sheen: Gloss.
6. Color: Quartz Blend - Q28-21.
7. Basis of Design Product: Dur-A-Flex; Dura-A-Quartz: www.dur-a-flex.com/#slee

D. Fluid-Applied Flooring Type EPX-03: Epoxy base coat(s), with broadcast aggregate.
1. Aggregate: Quartz broadcasts.
2. Top Coat: Urethane.
3. System Thickness: 3/16" inch (4.76 mm), nominal, dry film thickness (DFT).
4. Texture: Slip resistant.
5. Sheen: Gloss.
6. Color: Quartz Blend - Q28-23.
7. Basis of Design Product: Dur-A-Flex; Dura-A-Quartz: www.dur-a-flex.com/#slee

2.03 ACCESSORIES

A. Base Caps: Zinc continuous cove strip.

B. Cant Strips: Molded of flooring resin material and as needed and noted on drawings.

C. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.

D. Primer: Type recommended by fluid-applied flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive flooring.

C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for fluid-applied flooring installation by testing for moisture and alkalinity (pH).
1. Test as Follows:
a. Alkalinity (pH): ASTM F710.
b. Internal Relative Humidity: ASTM F2170.
c. Moisture Vapor Emission: ASTM F1869.
2. Obtain instructions if test results are not within limits recommended by fluid-applied flooring manufacturer.

E. If above tests do not meet manufacturer's requirement, notify Contracting Agency and do not proceed with preparation work.

F. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.

B. Prepare concrete surfaces according to manufacturer's written requirements.

C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.

D. Vacuum clean substrate.

E. Apply primer to surfaces required by flooring manufacturer.

3.03 INSTALLATION - ACCESSORIES

A. Install cant strips at base of walls where flooring is to be extended up wall as base.

B. Install terminating cap strip at top of base; attach securely to wall substrate.

3.04 INSTALLATION - FLOORING

A. Apply in accordance with manufacturer's instructions.

B. Apply each coat to minimum thickness required by manufacturer.

C. Finish to smooth level surface.

D. Cove at vertical surfaces.

3.05 FIELD QUALITY CONTROL

A. Test mockups and final installations to confirm nominal system thickness is provided and adhesion meets manufacturer's requirements.

3.06 PROTECTION

A. Prohibit traffic on floor finish for 48 hours after installation.

B. Barricade area to protect flooring until fully cured.

END OF SECTION 09 67 00

SECTION 09 84 36
SOUND-ABSORBING CEILING UNITS

PART 1 - PRODUCTS

1.01 SUMMARY

A. Section Includes:
   1. Polyester felt fiber ceiling components.
   2. Suspension systems

B. Related Sections / Work:
   1. Sections 09 90 00 – Painting and Coating

C. Qualification Data:
   1. Test Reports: Certified reports from independent agency substantiating compliance to governing requirements.
   2. Certificates: Manufacturer's certifications that products comply with specified requirements, including test reports showing compliance with specified tests and standards.
      a. Data substantiating manufacturer and installer qualifications.
      b. Certified data attesting fire rated materials comply with specifications.
   3. Manufacturer's Instructions: Detailed installation instructions and maintenance data.

1.02 REFERENCES

A. ASTM E 84 – "Standard Test Method for Surface Burning Characteristics of Building Materials"

B. ASTM E 488 – "Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements"

C. ASTM B 209 – "Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate"

D. ASTM C 423 – "Sound Absorption and Sound Absorption Coefficients by Reverberation Room Method"

E. ASTM E 580 – "Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint"

F. ASTM C 635 – "Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings"

G. ASTM C 636 – "Recommended Practice for Installation of Metal Ceiling Suspensions Systems for Acoustical and Lay-in Panels"

H. ASTM A 641 – "Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire"

I. ASTM A 653 – "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip process"

J. ASTM E 1264 – "Classification for Acoustical Ceiling Products"

1.03 SUBMITTALS

A. Product Data: Manufacturer's published literature, including specifications.

B. Product Certification: Manufacturer's certifications that products comply with specified requirements and governing codes including product data, laboratory test reports and research reports showing compliance with specified standards.

C. Shop Drawings: Submit shop drawings for reflected ceiling plans (RCP's), drawn to scale, and indicating penetrations and ceiling mounted items. Show the following details:
   1. Reflected Ceiling Plan(s): Indicating felt ceiling layout, ceiling mounted items and penetrations.
   2. Suspension System, Carrier and Component Layout.
   3. Details of system assembly and connections to building components.

D. Samples for Verification: Full-size units (or as specified below) of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics. Submit samples for each type specified.

1. 11" long felt panel units.
2. 11" long samples of each suspension component.

1.04 QUALITY ASSURANCE

A. Manufacturer/Installer Qualifications:
   1. Provide felt ceiling system and suspension system components produced by a single manufacturer to provide consistent quality in appearance and physical properties, without delaying the work.
   2. Perform installations using a firm with installers having no less than 3 years of successful experience on projects of similar size and requirements.

B. Regulatory Requirements:
   1. Fire Rating Performance Characteristics:
      a. Surface Burning Characteristics: Tested per ASTM E84 and complying with Class A requirements as follows:
         1) Flame Spread: 25 or less
         2) Smoke Developed: 450 or less
   2. Structural Criteria: Install and certify system to comply with structural requirements of governing codes.
   3. Installation Standard for Suspension System: Comply with ASTM C 636.

C. Pre-installation Conference: Conduct a conference, prior to start of installation, to review system requirements, shop drawings, and all coordination needs.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver system components in manufacturer's original unopened packages, clearly labeled.

B. Store components in fully enclosed dry space. Carefully place on skids, to prevent damage from moisture and other construction activities.

C. Handle components to prevent damage to surfaces and edges, and to prevent distortion and other physical damage.

1.06 PROJECT CONDITIONS

A. Begin system installations only after spaces are enclosed and weather-tight, and after all wet work and overhead work have been completed.

B. Prior to starting installations, allow materials to reach ambient room temperature and humidity intended to be maintained for occupancy.

1.07 WARRANTY

A. Provide specified manufacturer's warranty against defects in workmanship or discoloration.

B. This warranty shall remain in effect for a minimum period of one (1) year from date of Substantial Completion.

1.08 MAINTENANCE & EXTRA MATERIALS

A. Maintenance Instructions: Provide manufacturer's standard maintenance and cleaning instructions for finishes provided. Given the unique and special nature of our Felt ceiling products, steps should be taken (before and during installation, as well as over the lifetime of the ceiling) to avoid or minimize static and the accumulation of dust, lint, dirt or airborne particles on or around the felt.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Basis of Design Product and Manufacturer: Felt panel ceiling system Silentia manufactured by Maxxit Ceilings & Walls, Toronto, Ontario, Canada

2.02 SYSTEM MATERIALS

A. Felt panel ceiling system for interior installations (choose from one of the following systems):
   1. Linear Baffle - Straight

B. Panel Profile Type: 3/8" (nominal) thick PET (polyester) felt (60% recycled PET fiber)

1. Straight baffle with continuous aluminum channel in top of baffle – specialized scissor clip for 15/16” grid and EZ access adjustable for 1.5” Unistrut fasteners slide into baffle channel and attached to respective suspension systems.

C. Linear Suspension System Options:
   1. 15/16” x 1-1/2” T-Grid suspension system – Heavy Duty Class per ASTM C635
   2. Direct Hung Baffle
   3. Hangers:
      a. Hanger Wire: 12 gauge galvanized carbon steel hanger wire.

D. Surface Texture: Soft

E. Edge Profile: Square

F. Panel Finish/Color: Timbercast Wood Look, Natural Maple

2.03 ACCESSORY MATERIALS

A. Suspension Hook assembly with 1/16” Stainless Steel Woven Wire (Aircraft Cable). Hook assembly grips and locks cable in place for vertical adjustment. Hook designed to install in top of factory punched Felt Panel continuous rail or clip.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and structural framing to which acoustical felt panels attach or abut, with installer present, for compliance with requirements specified in this and other Sections that affect installation and anchorage, and other conditions affecting performance of felt panel ceilings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.

B. Measure each ceiling area and establish layout of acoustical felt pan units to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width units at borders, and comply with layout shown on reflected ceiling plans.

3.03 INSTALLATION

A. General: Install acoustical felt panel ceilings, per manufacturers shop drawings provided, per manufacturer's written instructions and to comply with publications referenced below.
   1. CISCA "Ceiling Systems Handbook"
   2. Standard for Ceiling Suspension System Installations - ASTM C 636
   3. Standard for Ceiling Suspension Systems Requiring Seismic Restraint - ASTM E 580
   4. IBC (International Building Code) Standard for Seismic Zone for local area

B. Suspend ceiling hangers from building's approved structural substrates and as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
   2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
   3. Where width of ducts and other construction within ceiling plenum produce hanger spacings that interfere with location of hangers at spacing required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Utilize supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
   4. Where used secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. Space hangers not more than 48" on-center, along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 12" from ends of each member.
6. Level grid to 1/8" in 10' from specified elevation(s), square and true.
7. Adjust suspension system runners so they are square (within .5 degree from 90 degrees) and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

C. Secure bracing wires to ceiling suspension members and to supports acceptable to Architect/Engineer and/or inspector. Suspend bracing from building's structural members and/or structural deck, as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs (unless directed otherwise).

D. Scribe and cut acoustical felt panel units for accurate fit at penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled felt sheet.

E. Install acoustical felt panel units in coordination with suspension system. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.

3.04 ADJUST AND CLEAN

A. Adjust components to provide uniform tolerances.

B. Replace all ceiling panels that are creased, faded, or otherwise damaged.

C. Clean exposed surfaces with vacuum or dusting. If necessary, panels can be wet cleaned with water, or non-solvent, non-abrasive commercial type cleaner.

END OF SECTION 09 84 36

SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Interior painting and coating systems.

C. Exterior painting and coating systems.

D. Scope:
   1. Finish surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
      a. Exterior:
         1) Metal: Aluminum, galvanized, steel and ferrous metals.
      b. Interior:
         1) Concrete, Walls and Ceilings: Poured concrete, precast concrete, unglazed brick, cement board, tilt-up, cast-in-place concrete, and plaster.
         2) Metal: Aluminum and galvanized, steel and ferrous metals..
         3) Metal: Structural steel columns, joists, trusses, beams, miscellaneous and ornamental iron, structural iron, and ferrous metal.
         4) Wood: Plywood walls.
         5) Drywall: Walls, ceilings, gypsum board, and similar items.

1.02 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: Shop-primed items.

B. Section 07 19 00 - Water Repellents.

C. Section 09 96 00 - High-Performance Coatings.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.

B. SCAQMD 1113 - Architectural Coatings 1977, with Amendment (2016).

C. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).

D. SSPC-SP 13 - Surface Preparation of Concrete 2018.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Product characteristics.
   2. Surface preparation instructions and recommendations.
   3. Primer requirements and finish specification.
   4. Storage and handling requirements and recommendations.
   5. Application methods.
   6. Clean-up information.

C. Samples: Submit four paper draw down samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.

D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

E. Applicator's qualification statement.

F. Maintenance Data: Submit coating maintenance manual including finish schedule showing where each product/color/finish was used, product technical data sheets, safety data sheets (SDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

G. Maintenance Materials: Furnish the following for Contracting Agency's use in maintenance of project.
   1. See Section 1-06.9 for additional maintenance materials and provisions.
   2. Extra Paint and Finish Materials: 1 gallon (4 L) of each color; from the same product run, store where directed.
   3. Label each container with color in addition to manufacturer's label.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience and approved by manufacturer.

1.06 MOCK-UPS

A. See Section 1-06.8 for additional mock-up requirements.

B. Provide one interior accent wall as directed by Contracting Agency to demonstrate color and finish.

C. Provide interior door and frame assembly indicating paint color, texture, and finish.

D. Locate as part of the final work.

E. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.

C. Paint Materials: Store at a minimum of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

D. Handling: Maintain a clean, dry storage area to prevent contamination or damage to materials.

1.08 FIELD CONDITIONS

A. Do not apply materials when environmental conditions are outside the ranges required by manufacturer.

B. Follow manufacturer's recommended procedures for producing the best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Products: Subject to compliance with requirements, provide Sherwin-Williams Company (The) products indicated; www.sherwin-williams.com/#sle.

B. Comparable Products: Products of approved manufacturers will be considered in accordance with Section 1-06.7, and the following:
   1. Products are approved by manufacturer in writing for application specified.
   2. Products that meet or exceed performance and physical characteristics of basis of design products.
   3. Other Acceptable Manufacturers:
      a. Benjamin Moore.
      b. Kelly Moore.
      c. PPG Industries.

2.02 PAINTINGS AND COATINGS

A. General:
   1. Provide factory-mixed coatings unless otherwise indicated.
   2. Do not reduce, thin, or dilute coatings or add materials to coatings unless specifically indicated in manufacturer's instructions.

B. Volatile Organic Compound (VOC) Content:

1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
   a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
   b. SCAQMD 1113 Rule.
   c. Architectural coatings VOC limits of State in which the project is located.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site, or other method acceptable to authorities having jurisdiction.

C. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

2.03 PAINT SYSTEMS - EXTERIOR

A. Metal: Aluminum, galvanized, steel and ferrous metals.
   1. Alkyd Systems, Water Based:
      a. Semi-Gloss Finish:
         1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
            (a) 5 mils wet, 2 mils dry per coat.
         2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Water Based Alkyd Urethane Enamel Semi-Gloss, B53-1150 Series: www.sherwin-williams.com/#sle.
            (a) 4 to 5 mils wet, 1.4 to 1.7 mils dry per coat.

2.04 PAINT SYSTEMS - INTERIOR

A. Concrete, Walls and Ceilings: Poured concrete, precast concrete, unglazed brick, cement board, tilt-up, cast-in-place concrete, and plaster.
   1. Latex Systems:
      a. Eg-Shel Finish High Performance (HP):
         1) 1st Coat: Sherwin-Williams Loxon Concrete and Masonry Primer Sealer, LX02W50 Series: www.sherwin-williams.com/#sle.
            (a) 8 mils wet, 3.2 mils dry per coat.
         2) 2nd and 3rd Coat: Sherwin-Williams ProMar 200 HP Zero VOC Eg-Shel, B20-1950 Series: www.sherwin-williams.com/#sle.
            (a) 4 mils wet, 1.7 mils dry per coat.

B. Metal: Aluminum and galvanized, steel and ferrous metals.
   1. Alkyd Systems, Water Based:
      a. Low Sheen Finish:
         1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
            (a) 5 mils wet, 2 mils dry per coat.
         2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Water Based Alkyd Urethane Enamel Low Sheen, B53-1250 Series: www.sherwin-williams.com/#sle.
            (a) 4 to 5 mils wet, 1.4 to 1.7 mils dry per coat.

C. Metal: Structural steel columns, joists, trusses, beams, miscellaneous and ornamental iron, structural iron, and ferrous metal.
   1. Alkyd Systems, Water Based:
      a. Semi-Gloss Finish:
         1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
            (a) 5 mils wet, 2 mils dry per coat.
         2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Water Based Alkyd Urethane Enamel Semi-Gloss, B53-1150 Series: www.sherwin-williams.com/#sle.
            (a) 4 to 5 mils wet, 1.4 to 1.7 mils dry per coat.

D. Wood: Plywood walls.
   1. Alkyd Systems, Water Based:

a. Low Sheen Finish:
1) 1st Coat: Sherwin-Williams Premium Wall and Wood Primer, B28W8111: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.8 mils dry per coat.
2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Water Based Alkyd Urethane Enamel Low Sheen, B53-1250 Series: www.sherwin-williams.com/#sle.
(a) 4 to 5 mils wet, 1.4 to 1.7 mils dry per coat.

E. Drywall: Walls, ceilings, gypsum board, and similar items.
1. Latex Systems:
a. Semi-Gloss Finish High Performance (HP): Restrooms, locker rooms and kitchen areas.
1) 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.5 mils dry per coat.
2) 2nd and 3rd Coat: Sherwin-Williams ProMar 200 HP Zero VOC Latex Semi-Gloss, B31-1950 Series: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.6 mils dry per coat.
b. Eg-Shel Finish High Performance (HP):
1) 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.5 mils dry per coat.
2) 2nd and 3rd Coat: Sherwin-Williams ProMar 200 HP Zero VOC Eg-Shel, B20-1950 Series: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.7 mils dry per coat.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Concrete:
1. Remove release agents, curing compounds, efflorescence, and chalk.
2. Fill bug holes, air pockets, and other voids with cement patching compound.
3. Prepare concrete according to SSPC-SP 13.

D. Gypsum Board: Fill minor defects with filler compound; sand smooth and remove dust prior to painting.

E. Aluminum: Remove surface contamination and oil; wash with solvent according to SSPC-SP 1.

F. Galvanized Surfaces:
1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
2. Prepare surface according to SSPC-SP 2.

G. Ferrous Metal:
1. Solvent clean according to SSPC-SP 1.
2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Prime bare steel surfaces.
3. Remove rust, loose mill scale, and other foreign substances using methods recommended by paint manufacturer and blast cleaning according to SSPC-SP 6. Protect from corrosion until coated.

H. Wood: Remove dust, grit, and foreign matter. Scrape, sand, and spot prime knots and pitch streaks. Fill nail holes and imperfections with wood filler and sand smooth.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions.

C. Apply coatings at spread rate required to achieve manufacturer's recommended dry film thickness.

D. Regardless of number of coats specified, apply additional coats until complete hide is achieved.

3.04 PRIMING

A. Apply primer to all surfaces unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

B. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to top coat manufacturers.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.06 PROTECTION

A. Protect finished coatings from damage until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 09 90 00

This page intentionally left blank

SECTION 09 96 00
HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. High performance coatings for concrete walls and bollards.

B. Surface preparation.

1.02 RELATED REQUIREMENTS

A. Section 09 67 00 - Fluid-Applied Flooring: High performance fluid-applied flooring systems.

B. Section 09 90 00 - Painting and Coating

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.

B. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating 2023.

C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association Current Edition.

D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.

E. SCAQMD 1113 - Architectural Coatings 1977, with Amendment (2016).

F. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).

G. SSPC-SP 2 - Hand Tool Cleaning 2018.

H. SSPC-SP 6 - Commercial Blast Cleaning 2007.

I. SSPC-SP 13 - Surface Preparation of Concrete 2018.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
   4. Manufacturer's installation instructions.

C. Samples: Submit two samples 8 by 8 inch (203 by 203 mm) in size illustrating colors available for selection.

D. Manufacturer's Certificate: Certify that high-performance coatings comply with VOC limits specified.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

G. Maintenance Data: Include cleaning procedures and repair and patching techniques.

H. Maintenance Materials: Furnish the following for Contracting Agency's use in maintenance of project.
   1. See Section 1-06.9 for additional maintenance provisions.
   2. Extra Coating Materials: 1 gallon (4 liters) of each type and color.
   3. Label each container with manufacturer's name, product number, color number, and description where used.

1.05 QUALITY ASSURANCE

A. Maintain one copy of each referenced document that applies to application on site.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum 7 years documented experience.

1.06 MOCK-UPS

A. See Section 1-06.8 for additional mock-up requirements.

B. Provide mock-up , 10 feet (3.1 m) long by 10 feet (3.1 m) wide, illustrating elastomeric coating, color, and surface sheen for each color.

C. Provide mock-up of two bollards illustrating coating, color and surface sheen.

D. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Coating Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the coating product manufacturer.

C. Do not install materials when temperature is below 55 degrees F (13 degrees C) or above 90 degrees F (32 degrees C).

D. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.

E. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

F. Restrict traffic from area where coating is being applied or is curing.

1.09 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for bond to substrate.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Only materials (primers, coatings, etc.) listed in the latest edition of the MPI Approved Product List (APL) are acceptable for use on this project.

B. Provide high performance coating products from the same manufacturer.

C. High-Performance Coatings:
   1. Dow: www.dow.com/#sle.
   2. PPG Paints: www.ppgpaints.com/#sle.
   3. Sherwin-Williams Company: www.protective.sherwin-williams.com/industries/#sle.
   4. Tnemec Company, Inc: www.tnemec.com/#sle.

2.02 HIGH-PERFORMANCE COATINGS

A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in MPI Approved Products List.

B. Provide coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:
   1. Lead Content: None.

C. Moderate Exposure: All minimum criteria.

2.03 TOP COAT MATERIALS

A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.
   1. Chromium Content, as Hexavalent Chromium, Zinc Chromate, or Strontium Chromate: None.
   2. Volatile Organic Compound (VOC) Content:
      a. Provide coatings that comply with the most stringent requirements specified in the following:
         1) 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
         2) SCAQMD 1113 Rule.
         3) Architectural coatings VOC limits of the State in which the Project is located.
      b. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
   3. Colors: Selected from manufacturer's standard colors.

B. Elastomeric Coating for concrete walls:
   1. Number of Coats: Two.
   2. Product Characteristics:
      a. Comply with the performance requirements specified above for moderate exposure.
   3. Top Coat(s): Exterior Pigmented Elastomeric, Water Based; MPI #113.
      a. Sheen: Flat.
      b. Products:
         1) Dow; DOWSIL ALLGUARD Silicone Elastomeric Coating: www.dow.com/#sle.
         2) PPG Paints; Perma-Crete Pitt-Flex Elastomeric Coating, 4-110XI Series, Flat: www.ppgpaints.com/#sle. (MPI #113)
         3) Tnemec Company, Inc; Series 156 Enviro-Crete: www.tnemec.com/#sle.
         4) Sherwin-Williams Company; ConFlex XL High Build Coating CF11W0051: www.protective.sherwin-williams.com/industries/#sle.
         5) Substitutions: See Section 1-06.7.
   4. Primer: As recommended by coating manufacturer for specific substrate.

C. Urethane Coating for metal bollards:
   1. Number of Coats: Two.
   2. Product Characteristics:
      a. Comply with the performance requirements specified above for moderate exposure.
   3. Top Coat(s): Polyurethane, Two-Component; MPI #72, #174.
      a. Sheen: Semi-Gloss.
      b. Products:
         1) PPG Paints; Pitthane High Build Urethane Enamel, 95-8800 Series, Semi-Gloss: www.ppgpaints.com/#sle.
         2) Sherwin-Williams Hi Solids Polyurethane 250, B65 Series: www.protective.sherwin-williams.com/#sle.
         3) Tnemec Company, Inc; Series 1095 Endura-Shield: www.tnemec.com/#sle.
         4) Substitutions: See Section 1-06.7.
   4. Primer: As recommended by coating manufacturer for specific substrate.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not begin application of coatings until substrates have been properly prepared.

C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

E. If substrate preparation is the responsibility of another installer, notify Contracting Agency of unsatisfactory preparation before proceeding.

F. Test shop-applied primer for compatibility with subsequent cover materials.

G. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.

H. Proceed with coating application only after unacceptable conditions have been corrected.
   1. Commencing coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION

A. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

B. Clean surfaces of loose foreign matter.

C. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.

D. Remove finish hardware, fixture covers, and accessories and store.

E. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
   2. Clean surfaces with pressurized water. Use pressure range of 1,500 to 4,000 psi (10,350 to 27,580 kPa) at 6 to 12 inches (150 to 300 mm). Allow to dry.
   3. Clean concrete according to ASTM D4258. Allow to dry.
   4. Prepare surface as recommended by coating manufacturer and according to SSPC-SP 13.

F. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   2. Prepare surface according to SSPC-SP 2.

G. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning", and protect from corrosion until coated.

3.03 PRIMING

A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

B. Concrete: Prior to priming, patch with masonry filler to produce smooth surface.

3.04 COATING APPLICATION

A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified and recommendations in MPI - Architectural Painting and Specification Manual.

B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.05 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Contracting Agency will engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
   1. Touch up and restore coated surfaces damaged by testing.
   2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, and specified thickness, Contractor shall pay for retesting and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations, and specified thickness.

3.06 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.07 PROTECTION

A. Protect finished work from damage.

END OF SECTION 09 96 00

This page intentionally left blank

SECTION 10 14 23
PANEL SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Panel signage.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

B. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.03 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Manufacturer's product literature for each type of panel sign, indicating styles, font, foreground and background colors, locations, and overall dimensions of each sign.

C. Shop Drawings:
   1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.
   2. Schedule: Provide information sufficient to completely define each panel sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
      a. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
      b. When content of signs is indicated to be determined later, request such information from Contracting Agency at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
      c. Submit for approval by Contracting Agency prior to fabrication.

D. Samples: Submit two samples of each type of sign, of size similar to that required for project, indicating sign style, font, and method of attachment.

E. Selection Samples: Where colors, materials, and finishes are not specified, submit two sets of color selection charts or chips.

F. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

G. Manufacturer's qualification statement.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

C. Store under cover and elevated above grade.

D. Store tape adhesive at normal room temperature.

1.06 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Panel Signage:
   1. Best Sign Systems, Inc: www.bestsigns.com/#sle.
   2. FASTSIGNS International, Inc: www.fastsigns.com/#sle.

3. Inpro Corporation: www.inprocorp.com/#sle.
4. Mohawk Sign Systems, Inc: www.mohawksign.com/#sle.
5. Seton Identification Products: www.seton.com/aec/#sle.
6. Takeform: www.takeform.net/#sle.
7. Vista System LLC: www.vistasystem.com/#sle.
8. Substitutions: See Section 1-06.7.

2.02 REGULATORY REQUIREMENTS

A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.03 PANEL SIGNAGE

A. Panel Signage:
1. Application: Room, door and evacuation map signs.
2. Description: Flat signs with applied character panel media, tactile characters.
3. Sign Size: 4 inches by 6 inches (100 mm by 152 mm) except evacuation map signage.
4. Total Thickness: 1/8 inch (3 mm).
5. Sign Edges: Squared.
6. Letter Edges: Squared.
7. Color and Font, unless otherwise indicated:
   a. Character Font: Helvetica, Arial, or other sans serif font.
   b. Character Case: Upper and lower case (title case).
   c. Background Color: As selected from manufacturer's standard colors.
   d. Character Color: As selected from manufacturer's standard colors.
8. Material: Acrylic plastic base with applied plastic letters and braille.
9. Profile: Flat panel without frame.
10. Tactile Letters: Raised 1/32 inch minimum.
11. Braille: Grade II, ADA-compliant.
12. One-Sided Wall Mounting: Tape adhesive.

2.04 SIGNAGE APPLICATIONS

A. Room and Door Signs:
1. Office Doors: Identify with room names and numbers to be determined later, not those indicated on drawings including braille.
2. Conference and Meeting Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings including braille.
3. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings including braille.
4. Rest Rooms: Identify with pictograms, the name "Unisex", room numbers to be determined later, including braille.

B. Emergency Evacuation Map Panel Signs:
1. Allow for 6 maps per building.
2. Map content to be provided by Contracting Agency in 8 1/2" x 11" format.

2.05 ACCESSORIES

A. Tape Adhesive: Double-sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Notify Contracting Agency if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install with horizontal edges level.

C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

D. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION 10 14 23

This page intentionally left blank

SECTION 10 26 00
WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall corner guards.

1.02 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware: Standard protection plates and trim.

B. Section 09 21 16 - Gypsum Board Assemblies: Placement of supports in stud wall construction.

1.03 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.

C. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
   1. Submit two sections of corner guards, 24 inches (610 mm) long.

D. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.

E. Maintenance Materials: Furnish the following for Contracting Agency's use in maintenance of project:
   1. See Section 1-06.9 for additional maintenance provisions.
   2. Extra Stock Materials: One package(s) of minimum 96 inches (2438 mm) long unit of each kind of covers for corner guards.

F. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.

B. Protect work from moisture damage.

C. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.

D. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.05 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Corner Guards:
   1. Babcock-Davis: www.babcockdavis.com/#sle.
   2. Inpro: www.inprocorp.com/#sle.
   3. Koroseal Interior Products: www.koroseal.com/#sle.
   4. Substitutions: See Section 1-06.7.

2.02 PRODUCT TYPES

A. Corner Guards - Flush Mounted:
   1. Material: Type 304 stainless steel, No. 4 finish, 16 gauge, 0.0625 inch (1.587 mm) thick.

2. Performance: Resist lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
3. Width of Wings: 2 inches (51 mm).
4. Corner: Square.
5. Length: One piece.

B. Adhesives and Primers: As recommended by manufacturer.

2.03 FABRICATION

A. Fabricate components with tight joints, corners and seams.

2.04 SOURCE QUALITY CONTROL

A. Provide wall protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

B. Verify that field measurements are as indicated on drawings.

C. Verify that substrate surfaces for adhered items are clean and smooth.
1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.

D. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.

B. Position corner guard 4 inches (102 mm) above finished floor to 100 inches high (2540 mm high).

3.03 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch (6 mm).

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch (6 mm).

3.04 CLEANING

A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION 10 26 00

SECTION 10 28 00
TOILET, BATH, LAUNDRY AND CLEANING ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Commercial shower and bath accessories.

C. Diaper changing stations.

D. Foot cleaning accessories.

1.02 RELATED REQUIREMENTS

A. Section 22 40 00 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

1.03 REFERENCE STANDARDS

A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service 2022.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2023.

C. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium 2017 (Reapproved 2022).

D. ASTM C1036 - Standard Specification for Flat Glass 2021.

E. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror 2018.

F. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS TOILET AND BATHSHOWER ACCESSORIES

A. Commercial Toilet, Shower, and Bath Accessories:
   1. AJW Architectural Products: www.ajw.com/#sle.
   2. American Specialties, Inc: www.americanspecialties.com/#sle.
   3. Bradley Corporation: www.bradleycorp.com/#sle.
   4. Bobrick Washroom Equipment, Inc; www.bobrick.com/#sle
   5. Koala Kare Products: www.koalabear.com/#sle.
   6. Substitutions: See Section 1-06.7.

B. Provide products of each category type by single manufacturer.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

B. Keys: Provide keys for each accessory to Contracting Agency; master key lockable accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.

E. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

F. Adhesive: Two component epoxy type, waterproof.

G. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

H. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.

2.04 COMMERCIAL TOILET ACCESSORIES

A. Toilet Paper Dispenser: Double roll, surface-mounted, stainless steel unit swing down door and, tumbler lock.
   1. Basis of Design Manufacturer and Product: Bobrick Washroom Equipment, Inc.; Surface-Mounted Twin Jumbo-Roll Toilet Tissue Dispenser B-2892.

B. Combination Towel Dispenser/Waste Receptacle: Recessed flush with wall, stainless steel; seamless wall flanges, continuous piano hinges, tumbler locks on upper and lower doors.
   1. Waste receptacle liner: Reusable, heavy-duty vinyl.
   2. Towel dispenser capacity: 600 C-fold or 800 multifold paper towels.
   3. Waste receptacle capacity: 12 gallons (45 liters).
   4. Basis of Design Manufacturer and Product: Bobrick Washroom Equipment, Inc.; ClassicSeries® Recessed Convertible Paper Towel Dispenser And Waste Receptacle B-3944.

C. Automated Soap Dispenser: Foam soap dispenser, wall-mounted, with stainless steel cover and window to gauge soap level, lock.
   1. Minimum Capacity: 27 ounces (0.8 liters).
   2. Basis of Design Manufacturer and Product: Bobrick Washroom Equipment, Inc.; Automatic Wall-Mounted Foam Soap Dispenser B-2013.

D. Mirrors: Stainless steel framed, 1/4 inch (6 mm) thick annealed float glass; ASTM C1036.
   1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
   2. Sizes: As indicated on drawings.
   3. Frame: 0.05 inch (1.3 mm)angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
   4. Backing: Full-mirror sized, minimum 0.03 inch (0.8 mm) galvanized steel sheet and nonabsorptive filler material.
   5. Basis of Design Manufacturer and Product: Bobrick Washroom Equipment, Inc.; Glass Mirror With Stainless Steel Angle Frame B-290 Series.

E. Seat Cover Dispenser: Stainless steel, surface-mounted, reloading by concealed opening at base.
   1. Minimum capacity: 250 seat covers.
   2. Basis of Design Manufacturer and Product: Bobrick Washroom Equipment, Inc.; ClassicSeries® Surface-Mounted Seat-Cover Dispenser B-221.

F. Grab Bars: Stainless steel, smooth surface.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
      b. Dimensions: 1-1/2 inch (38 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, concealed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
      c. Finish: Satin.

d. Length and Configuration: As indicated on drawings.
e. Basis of Design Manufacturer and Product: Bobrick Washroom Equipment, Inc.; 1 1/2" Diameter Stainless Steel Grab Bars With Snap Flange B-6806 Series.

G. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with stainless steel piano-type hinge, removable receptacle.
1. Finish: Satin.
2. Basis of Design Manufacturer and Product: Bobrick Washroom Equipment, Inc.; Surface-Mounted Sanitary Napkin Disposal B-254.

2.05 COMMERCIAL SHOWER AND BATH ACCESSORIES

A. Shower Curtain Rod: Stainless steel tube, 1 inch (25 mm) outside diameter, 0.04 inch (1.0 mm) wall thickness, satin-finished, with 3 inch (75 mm) outside diameter, minimum 0.04 inch (1.0 mm) thick satin-finished stainless steel flanges, for installation with exposed fasteners.
1. Basis of Design Manufacturer and Product: Bobrick Washroom Equipment, Inc.; Heavy-Duty Shower Curtain Rod with Concealed Mounting B-207.

B. Shower Curtain:
1. Material: Opaque vinyl, 0.008 inch (0.2 mm) thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
2. Size: Minimum 42 by 72 inches (1067 mm), hemmed edges.
3. Grommets: Stainless steel; pierced through top hem on 6 inch (150 mm) centers.
4. Color: White.
5. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
6. Basis of Design Manufacturer and Products: Bobrick Washroom Equipment, Inc.; Vinyl Shower Curtains 204-2 and Stainless Steel Shower Curtain Hooks 204-1.

C. Robe Hook: Heavy-duty stainless steel, double-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.
1. Basis of Design Manufacturer and Product: Bobrick Washroom Equipment, Inc.; Surface-Mounted Double Robe Hook B-76727.

2.06 UNDER-LAVATORY PIPE AND SUPPLY COVERS

A. Specified in 22 40 00 - Plumbing Fixtures.

2.07 DIAPER CHANGING STATIONS

A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
1. Material: Stainless steel.
2. Mounting: Recessed.
3. Minimum Rated Load: 250 pounds (113.4 kg).
a. Basis of Design Manufacturer and Product: Koala Kare; Horizontal Stainless Steel Recessed-Mounted Baby Changing Station KB310-SSRE.

2.08 FOOT CLEANING ACCESSORIES

A. Foot/Boot Cleaning Brush with Base:
1. Brush Size: 9 inches in length by 6 inches in width by 5 inches in height.
2. Base Size: 22 inches in length by 6 inches in width by 1 inch in height.
3. Finish: Black Satin.
4. Basis of Design Manufacturer and Product: Original Scrusher with base Model #H1PB: www.scrusher.com/#sle.
5. Manufacturers:
a. Scrusher; www.scrusher.com/#sle.
b. Mr. Boot Cleaner; www.mrbootcleaner.com/#sle.
c. Weiler; www.weilerabrasives.com/#sle.
d. Substitutions: See Section 1-06.7.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

D. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
   1. Grab Bars: As indicated on drawings.
   2. Mirrors: Maximum 40 inch (1016 mm), measured from floor to bottom of mirrored surface.
   3. Other Accessories: As indicated on drawings.

3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 10 28 00

SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).

B. FM (AG) - FM Approval Guide Current Edition.

C. NFPA 10 - Standard for Portable Fire Extinguishers 2022.

D. UL (DIR) - Online Certifications Directory Current Edition.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, anchorage details, and installation instructions.

C. Shop Drawings: Indicate locations of cabinets, cabinet physical dimensions, rough-in measurements for recessed cabinets, locations of individual fire extinquishers, mounting measurements for wall bracket, installation procedures, and accessories required for complete installation.

D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.05 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:
   1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com/#sle.
   2. Ansul, a Tyco Business: www.ansul.com/#sle.
   3. Nystrom, Inc: www.nystrom.com/#sle.
   4. Substitutions: See Section 1-06.7.

B. Fire Extinguisher Cabinets and Accessories:
   1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com/#sle.
   2. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.
   3. Nystrom, Inc: www.nystrom.com/#sle.
   4. Substitutions: See Section 1-06.7..

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Class: A:B:C type.
   2. Size: 10 pound (4.54 kg).
   3. Finish: Baked polyester powder coat, red color.
   4. Temperature range: Minus 40 degrees F (Minus 40 degrees C) to 120 degrees F (49 degrees C).

2.03 FIRE EXTINGUISHER CABINETS

A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.

B. Cabinet Construction: Non-fire rated.
   1. Formed primed steel sheet; 0.036 inch (0.9 mm) thick base metal.

C. Cabinet Configuration: Semi-recessed type.

D. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.

E. Door Glazing: Float glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.

F. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

G. Fabrication: Weld, fill, and grind components smooth.

H. Finish of Cabinet Exterior Trim and Door: Anodized to clear color.

I. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

B. Lettering: FIRE EXTINGUISHER decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, 32 inches (813 mm) from finished floor to inside bottom of cabinet.

C. Secure rigidly in place.

D. Place extinguishers in cabinets.

3.03 MAINTENANCE

A. See Section 1-06.9 for additional maintenance provisions.

3.04 MAINTENANCE - SELF-SERVICE FIRE EXTINGUISHERS

A. Annual Inspections: Inspect self-service fire extinguishers on annual basis in accordance with manufacturer’s instructions, and requirements of the authorities having jurisdiction (AHJ).

B. Inspection Certification Tag: Provide new tag indicating acceptable condition of fire extinguisher, date of inspection, and name of self-service inspector for each inspection.

END OF SECTION 10 44 00

SECTION 10 51 13
METAL LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal lockers.

B. Locker benches.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.

D. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.03 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.

C. Shop Drawings: Indicate locker plan layout, numbering plan.

D. Samples: Submit two samples 3 by 6 inches (75 by 150 mm) in size showing color and finish of metal locker material.

E. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Lockers and Benches:
   1. ASI Storage Solutions: www.asi-storage.com/#sle.
   2. Penco Products, Inc: www.pencoproducts.com/#sle.
   3. Republic Storage Systems Co: www.republicstorage.com/#sle.
   4. Substitutions: See Section 1-06.7.

2.02 LOCKER APPLICATIONS

A. Basis of Design Manufacturer and Product: Penco Products, Inc; Vanguard, knock-down lockers: www.pencoproducts.com/#sle.

B. Wardrobe Lockers: Metal lockers, wall mounted for base indicated on drawings.
   1. Width: 18 inches (457 mm).
   2. Depth: 18 inches (457 mm).
   3. Height: 72 inches (1830 mm).
   4. Configuration: Two tier.
   5. Fittings: Size and configuration as indicated on drawings.
      a. Hat shelf.
      b. Coat rod.
      c. Hooks: One double prong.
   6. Ventilation: Louvers at top and bottom of door panel.
   7. Locking: Padlock hasps, for padlocks provided by Owner.
   8. Provide sloped top.
   9. Color: To be selected from manufacturer's full range by Contracting Agency.

2.03 METAL LOCKERS

A. Accessibility: Design units indicated on drawings as 'accessible' to comply with ICC A117.1 and ADA Standards.

B. Locker Case Construction:
   1. Standard-Duty, Knocked Down Construction: Made of formed sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
      a. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
         1) Perforated Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M and the following:
            (a) Zinc-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation G60/Z180.
            (b) Perforations: Manufacturer's standard pattern of holes.
         2) Body and Shelves: 24 gauge, 0.0239 inch (0.61 mm).
         3) Backs: 24 gauge, 0.0239 inch (0.61 mm).
      b. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
         1) Door Frame: 16 gauge, 0.0598 inch (1.52 mm), minimum.
      c. Where ends or sides are exposed, provide flush panel closures.
      d. Provide filler strips where indicated, securely attached to lockers.

C. Latches and Door Handles: Manufacturer's standard.
   1. Latching: Manufacturer's standard for locking arrangement selected.
      a. Three-Point Pull Handle Gravity Latch: Surface-mounted, provide for doors 18 inches (457 mm) or taller.
         1) Handle: Steel finger lift mechanism.
         2) Latching Mechanism: Spring activated nylon slide latch enclosed in steel latch channel allows closing of door while padlock or built-in lock is in position.
         3) Padlock Eye: Integral with lift handle, sized for use with 9/32 inch (7.1 mm) diameter padlock shackles.
         4) Lock Hole Filler Plate: Manufacturer's standard. Provide for lockers intended to be unsecured or secured with padlocks.
         5) Rubber bumpers riveted to door stops for silent operation.

D. Hinges: Heavy-duty, 5-knuckle type; two for doors under 42 inches (1050 mm) high; three for doors over 42 inches (1 050 mm) high.

E. Sloped Top: 20 gauge, 0.0359 inch (0.91 mm), with closed ends.

F. Trim: 20 gauge, 0.0359 inch (0.91 mm).

G. Coat Hooks: Stainless steel or zinc-plated steel.

H. Number Plates: Provide rectangular shaped aluminum plates. Form numbers 3/8 inch (9.5 mm) high of block font style with ADA designation, in contrasting color.

I. Locks: Locker manufacturer's standard type indicated in Applications article above.

2.04 LOCKER BENCHES

A. Basis of Design Manufacturer and Product: Penco Products, Inc; Stationary benches with two heavy duty pedestals to be attached to concrete slab: www.pencoproducts.com/#sle.

B. Locker Benches: Stationary type; bench top of laminated selected hardwood, 1-1/4” full finished thickness, all corners rounded and sanded; painted steel pedestals.
   1. Accessibility: Comply with ICC A117.1 and ADA Standards.
   2. Pedestal Height: 16 1/4 inch (413 mm).
   3. Bench Length: 48 & 42" inches (1219 & 1067 mm). See Drawings.
   4. Load Capacity per Bracket: 400 pounds (181 kg).
   5. Pedestal Finish: As selected by Contracting Agency from manufacturer's available options..

6. Pedestal Spacing: 36 inches on center (914 mm on center), maximum. Project-specific spacing to be determined based on field measurements.
7. Pedestals:
   a. Shall consist of steel tubing with 11 gauge steel flanges welded to each end.
   b. Overall height of shall be 16-1/4”.
   c. Pre-drill for bench top material attachment and base attachment to floor.
   d. Finished to match the lockers unless otherwise noted.
8. Bench Tops: To be 9-1/2” wide by 1 1/4" thick and furnished in lengths noted above. Surfaces shall be selected hardwood finished with two coats of clear lacquer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared bases are in correct position and configuration.

B. Verify bases and embedded anchors are properly sized.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Place and secure on prepared base.

C. Install lockers plumb and square.

D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds (445 N).

E. Bolt adjoining locker units together to provide rigid installation.

F. Install end panels, filler panels, and sloped tops.

G. Install fittings if not factory installed.

H. Replace components that do not operate smoothly.

3.03 CLEANING

A. Clean locker interiors and exterior surfaces.

END OF SECTION 10 51 13

This page intentionally left blank

SECTION 10 56 13
METAL STORAGE SHELVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Four post shelving.

B. Shelving accessories.

1.02 RELATED REQUIREMENTS

A. Section 09 21 16 - Gypsum Board Assemblies: Blocking and reinforcement in walls for anchoring shelving units.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Rated uniform shelf loads.
   2. Details of shelving assemblies, including reinforcement.
   3. Accessories.
   4. Substrate preparation instructions and recommendations.
   5. Storage and handling requirements and recommendations.
   6. Installation methods.
   7. Specimen warranty.
   8. Maintenance methods.

C. Test Reports: Provide independent agency test reports documenting compliance with specified structural requirements.
   1. In lieu of test reports, detailed drawings stamped and sealed by a Professional Engineer licensed in the State in which the Project is located will be acceptable.

D. Shop Drawings: Indicate location, type, and layout of shelving, including lengths, heights, and aisle layout, and relationship to adjacent construction.
   1. Indicate methods of achieving specified anchoring requirements.

E. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and finishes.

F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Contracting Agency's name and registered with manufacturer.

G. Maintenance Materials: Furnish the following for Contracting Agency's use in maintenance of project.
   1. See Section 1-06.9 for additional maintenance provisions.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of documented experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inspect for dents, scratches, or other damage. Replace damaged units.

B. Store in manufacturer's unopened packaging until ready for installation.

C. Store under cover and elevated above grade.

1.07 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Provide one year manufacturer warranty covering defects of manufacturing and workmanship and rust and corrosion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Four Post Shelving:
1. ASI Storage Solutions: www.asi-storage.com/#sle.
2. Hallowell: www.hallowell-list.com/#sle.
3. List Industries, Inc: www.listindustries.com/#sle.
4. Montel: www.montel.com/#sle.
5. Penco Products, Inc: www.pencoproducts.com/#sle.
6. SpaceSaver Corporation: www.spacesaver.com/#sle.
7. Tennsco Storage: www.tennsco.com/#sle.
8. Substitutions: See Section 1-06.7.

2.02 SHELVING - GENERAL

A. See drawings for layout and sizes.

B. Seismic Design: Design in accordance with applicable building code and reference general seismic design criteria noted on structural drawings.

C. Anchors: Provide anchoring hardware to secure each shelving unit to floor.
1. Provide hardware of type recommended by manufacturer for substrate.
2. See drawings for additional details of anchorage.

2.03 FOUR POST PALLET SHELVING

A. Four Post Pallet Shelving: Steel post-and-beam type with sway bracing, shelving brackets, shelving surfaces, and accessories as specified.
1. Basis of Design Manufacturer and Product: Penco Products, Inc; Penco Pallet Rack Plus - Seismic-Rated Pallet Racks: www.pencoproducts.com/#sle.
2. Unit Width: 42 inches (1067 mm), center to center of posts.
3. Shelf Capacity: Uniform distributed load of 100 psf (4.8 kPa), minimum.
4. Shelf Deflection: 1/4 inch (6 mm) in 36 inches (914 mm), maximum, under specified uniform load.
5. Shelf Deflection: L/140, maximum, under specified uniform load.
6. Adjustability of Shelving: At intervals of 3 inches (75 mm) on center, minimum.
7. Shelf Depth: 42 inches (1067 mm).
8. Unit Lengths: 120 inches (3048 mm).
9. Unit Depth: Not more than 1/4 inch (6 mm) greater than shelf depth.
10. Shelf Locations: 4, 8, and 12 feet.
11. Shelves per Unit: 3.
12. Unit Height: 12 feet (3658 mm), overall .
13. Finish: Baked enamel, medium gloss.
14. Color: Manufacturer’s standard gray.
15. Provide single-face units only.
16. Number of Units: As indicated on drawings.

B. Posts and Beams: Formed members; perforations exposed on face of members are not acceptable.
1. Post Shape: Square posts.
2. Post Face Width: 2 inches (51 mm), maximum.
3. Connecting Hardware: Manufacturer's standard.
4. Post Bases: Flat steel foot plate , with manufacturer’s recommended adjustable leveling device.

C. Bracing: Formed sheet members.
1. Back Sway Bracing: Strap type; at back of each unit.
2. Side Sway Bracing: Steel members; at each side of each unit.

3. Strap Sway Bracing: One strap installed diagonally, 16 gauge, 0.0598 inch (1.52 mm); welded, riveted, or bolted to uprights.

2.04 ACCESSORIES

A. Row Spacers for back to back units.

B. Wire decking in between shelf beams for safety.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate is level and that clearances are as specified.

B. Do not begin installation until substrates have been properly prepared.

C. If substrate preparation is the responsibility of another installer, notify Contracting Agency of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Anchor and reinforce as specified, as indicated on drawings, and as recommended by manufacturer.

C. Install shelving with shelf surfaces level and vertical supports plumb; adjust feet and bases as required.

D. Out-Of-Square Tolerance - Four Post Shelving: Maximum of 1/8 inch (3 mm) difference in distance between bottom shelf and canopy top, measured along any post in any direction.

3.04 CLEANING

A. Clean shelving and surrounding area after installation.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 10 56 13

This page intentionally left blank

SECTION 10 56 29
VERTICAL TIRE STORAGE CAROUSEL

PART 1 GENERAL

1.01 FURNISHED BY CONTRACTOR INSTALLED BY CONTRACTOR (FCIC)

A. Automated Vertical Storage Rack (Tire Carousel) shall be Furnished by Contractor, Installed by Contractor (FCIC)

1.02 SYSTEM DESCRIPTION

A. Equipment item is listed below by Equipment I.D. Tag.
   1. Tire Carousel, 60 to70 Tire Capacity with Tire Loading Ramp and Installation.
      a. Equipment I.D. Tag: TR-01 (Qty. 1)

B. Closed Industrial Metal Storage Shelving system(s)
   1. This section includes the specifications for the closed industrial vertical tire storage carousel system(s) being installed for storage & selection of tires in various sizes, weights, and areas as noted in the Bid Specifications and Bid Drawing Package.

C. Closed Industrial Vertical Tire Storage Carousel system – Description of System(s)
   1. The configurations for tire storage are described below.
      a. Closed Industrial Vertical Tire Storage Carousel Freestanding system: Product is stored in a “stand alone” metal shelf frame system.

D. Seismic Calculations
   1. For seismic calculations, use a shelf load of 250 (lbs.) PLF of shelf and a 100% utilization factor. Reference general seismic design criteria noted on Sheet S0.1 Division 1 – General, A.9.

E. List of Applicable Forms
   1. The General Conditions, Supplementary Conditions, Instructions to Bidders, Bid Form, all apply to these bid items.

1.03 DESCRIPTION OF WORK

A. List of Work
   1. The extent of the Work is shown on the drawings and is defined to include (but not by way of limitations) all labor, materials, freight, unloading, equipment, taxes, permits and supervision required for the fabrication and installation of the closed industrial metal storage systems. The Closed Industrial Vertical Tire Storage Carousel Freestanding system shall include label holders, clips, cross bars, beams, bolts, shims and all 1 of 7 other materials necessary for the desired performance. Wall ties, column ties, or any other method of affixing storage system to the building walls or structure is not permitted.

B. Coordination
   1. Contractor’s Responsibility: It will be the Contractor's responsibility to verify and establish a detailed installation schedule.
   2. Field Check: ALL BUILDING AND EQUIPMENT LAYOUT DIMENSIONS SHALL BE FIELD CHECKED AND VERIFIED BY CONTRACTOR PRIOR TO START OF INSTALLATION. NOTIFY THE CONSULTANT AND OWNER OF ANY DISCREPANCIES OR CONDITIONS AFFECTING MATERIALS AND/OR INSTALLATION WITHIN TEN (10) DAYS. IF A CONDITION EXISTS AND THE CONSULTANT OR OWNER IS NOT NOTIFIED THE ADDITIONAL COST TO CORRECT THE INSTALLATION IN ACCORDANCE WITH THE REQUIREMENTS OF THE OWNER WILL BE THAT OF THE CONTRACTOR.
   3. Delivery and Unloading: The Closed Industrial Vertical Tire Storage Carousel System Contractor shall be responsible for coordinating the delivery and unloading of the equipment to the job-site with the General Contractor to eliminate demurrage charges, unless authorized by the Owner or the Consultant. In order to eliminate disruption to the ongoing operations and prevent interference of dock access by trucks entering and leaving the site, temporary staging of materials will be provided outside of the building at a location designated by the Owner. The Closed Industrial Vertical Tire Storage Carousel

System Contractor shall provide storage facilities (i.e., covers, closed containers) to protect equipment from the elements (i.e., dust, dirt, rain, ice, snow, etc.) as necessary. Interior staging of equipment will be kept to a minimum so as not to disrupt ongoing operations.

1.04 QUALITY ASSURANCE

A. Standards
   1. Equipment Standards: The equipment covered by these Specifications shall be designed, assembled, tested and installed in accordance with the latest applicable standards, including:
      a. American National Standards Institute (ANSI).
      b. American Iron and Steel Institute.
         1) Specification for Design of Cold-Formed Steel Association - "Structural Members" 2015 edition.
      c. International Building Code (IBC)
         1) International Building Code including current Building Code Amendments. (2015 Edition)
   2. Materials
      a. All materials furnished shall be new, free from defects, and UL-Approved where such approval is granted to the equipment to be furnished.
   3. Federal Inspection
      a. Latest published applicable Federal Specifications.
   4. OSHA
      a. Applicable OSHA Specifications.
   5. Building and Safety Codes
      a. Any applicable local building and safety codes pertaining to the Work.

B. Workmanship
   1. Trade Methods: Use the best trade methods throughout. Work evidencing substandard workmanship shall be corrected or replaced by the Contractor at the Contractor's expense, per the General Conditions.
   2. Welding: Areas to be welded shall be free from rust, grease, or other foreign matter for a distance of at least one-half inch (1/2") back from the edge of the weld. Prevent warping in finished product; use jigs, if necessary. Grind welds smooth on exterior exposed surfaces. All Work to standard tolerances, careless template work is not acceptable. All welds to be painted to match factory finish.
   3. Touch Up Paint: The method for the touch up of paint shall follow specifications section 3.02 Field Painting.

C. Guarantees
   1. WARRANTY:
      a. Warranty shall be the manufacturer's standard warranty and shall be specified by the Contractor in the contents of the proposal.
      b. The contractor shall provide an extended warranty for a period of three (3) years from Date of Acceptance.
   2. QUALITY OF MATERIALS AND EQUIPMENT: The Contractor guarantees the material and equipment delivered under the Contract to be free from defects in design or workmanship and against damages caused prior to final inspection. Unless otherwise specified, this guarantee extends for a period of three (3) years from the Date of Acceptance for both labor and materials.
   3. REPAIRING DEFECTS: The Contractor shall promptly repair or replace all defective or damaged items delivered under the Contract. The Tire Carousel Contractor may elect to have any replaced item returned to his/her plant at his/her expense.
   4. STRUCTURAL DESIGN: It is the Contractor's responsibility to guarantee a functional and structurally sound Tire Carousel design in accordance with the drawings, specifications, and codes.

1.05 SUBMITTALS

A. Product Data: Submit latest edition of Tire Carousel data sheet and outline drawing with the proposal.

B. Shop Drawings:
   1. Shop Drawings, as stated in the General Conditions, shall include, but need not be limited to:
      a. Installation Plan: Proposed installation plan of vertical tire, including location and dimensions of new equipment clearly identified. It will be the Contractor's responsibility to verify and establish a detailed installation schedule per the General Conditions.
      b. Supports and Bracing: Coordination, location and detail vertical tire carousel, lateral supports and bracing. Coordinate with the Carousel Contractor for support beams and connections.
      c. Dimensions: Elevation views showing all component dimensions and all product and aisle clearance dimensions.
      d. Bill of Materials: Bill of Materials per the General Conditions.
      e. Calculations: Shop drawings, load, and seismic calculations shall be submitted within twenty-one (21) days after receipt of order.

C. Approved Shop Drawings
   1. It will be the Contractor's responsibility to obtain approved shop drawings signed by the Consultant and/or Owner per the General Conditions prior to fabrication.

D. Manufacturer’s Reference:
   1. Prime Manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

      Vidir Solutions

      19 East Lehman Street

      Lebanon, PA 17046 USA

      Phone: (800) 210-0141

      Website: https://vidirsolutions.com/

      Model: HT54

E. Other manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers may be considered as equal.

PART 2 PRODUCTS

2.01 INDUSTRIAL VERTICAL TIRE CAROUSEL STORAGE SYSTEM GENERAL

The Contractor shall provide the following:

A. List of Required Items

New Closed Industrial Vertical Tire Storage Carousel system as shown on the drawings, including freight, unloading, installation, touch-up painting, cleaning, and other equipment necessary to complete the system.

B. Quantity and Capacity

See drawings Q1.00, Q1.02 for equipment location and configuration.

C. Standard Designs

Components shall be of standard design and fabrication by the manufacturer so that all may be replaced or purchased at a future date without special charges or extended deliveries.

The Bill of Materials for this Work is to be determined by the Contractor from the bid drawings and contents of the Specifications. Vertical Tire Storage Carousel System

Contractor to verify all information.

D. Codes

The Closed Industrial Vertical Tire Storage Carousel system shall be designed and installed to the exact standards of the manufacturer and in all cases shall conform to applicable codes. The Closed Industrial Metal Storage Shelving contractor will submit manufacturer's certified design calculations for the Carousel system to the Owner or Consultant for review.

E. Loads and Capacity

The Vertical Tire Storage Carousel System shall be designed to handle loads under normal, impact loading conditions experienced in a manual loading application.

The Vertical Tire Storage Carousel System Freestanding system components shall utilize materials of a sufficient capacity to accept the stated load conditions without infringing upon the published Load Safety Factor of the load bearing members.

F. Vertical Tire Storage Carousel System Deflection Allowed

Load beams shall be designed for maximum deflection of 1/180th of the clear span when loaded to 100% of manufacturer's rated capacity.

G. Finish

Finish will be lead free baked enamel with color and finish subject to selection and approved by consultant and Owner

H. Erection

All shipments of the Vertical Tire Storage Carousel System, Freestanding system shall include all components to allow immediate erection upon receipt.

I. Anchoring

All work must be rigid and anchored securely, use 1/2" through bolts and lock nuts. Method of attachment to be approved prior to installation.

J. Anchor Holes

All anchor holes are to be vacuum cleaned at time of drilling to prevent dust build up and spreading of sawdust and metal shavings. Spreading of dust or debris onto other equipment because of not vacuum cleaning at time of drilling will require the Vertical Tire Storage Carousel System Contractor to clean other work that may be affected.

K. Touch Up

The Closed Industrial Vertical Tire Storage Carousel, Freestanding System Contractor shall touch up any other Contractor's work damaged during the process per section 3.02 Field Painting.

2.02 VIDIR TIRE CAROUSEL STORAGE SYSTEM, EQUIPMENT TAG # TR-01 (QTY. 1)

A. General:
   1. Description: Vertical Tire Storage Carousel unit in the Tire Shop used for storage of tires.

B. Physical Data:
   1. Overall Dimensions:
   2. Width: 14'-11"
   3. Depth: 9'-1"
   4. Height: 15'-2""
   5. Number of Carriers: 5

6. Carrier Width: 12’-5”
7. Max. tire diameter: 44”
8. Tire Quantity: 65 (Based on 11” wide tires)
9. Shelf (Carrier) Capacity: 2,000 lbs.
10. Live Load: 17,860 lbs.

C. Features and Construction:
1. Semi-Automated Controls w/ Keypad
2. Load per carrier: 2,000 lbs.
3. Maximum Unit Imbalance: 2,500 lbs.
4. 21’ per minute retrieval speed
5. 2 x Tire Dividers per carrier
6. 2” mesh guarding front and back
7. Tire Ramp
8. 2-year Manufacturer’s warranty

D. Finish: Durable enamel in manufacturer’s standard color (White with Grey Interior)

E. Electrical Requirements: 208V/230V, 15Amp, 60Hz, 3 Phase

PART 3 EXECUTION

3.01 EXAMINATION

A. Coordination

B. Each Contractor must give careful consideration to the ongoing facility operations and the work of other contractors during the entire project and shall organize his/her work so that it will not interfere with ongoing operations or interfere with or delay the work of others. Minimal disruption to ongoing operations is a priority. It is imperative that the schedule be maintained with any changes coordinated promptly with the General Contractor, Owner, and Consultant.

C. General Description

D. The Vertical Tire Storage Carousel System shall be installed true and properly aligned complete in all details and in accordance with the specifications, manufacturer's recommendations, and the drawings.

E. Joints

F. All joints shall be finished smooth and free from snags or protrusions, which, in the opinion of the Owner or Consultant, could cause safety hazards or be esthetically unpleasant.

G. Installation Routine

H. Installation shall include unloading, checking and security of equipment prior to erection, shimming, complete anchoring, touch up and cleaning. The Contractor shall provide storage facilities (i.e., covers, closed containers) to protect equipment from the elements (i.e., dust, dirt, rain, snow, etc.). Contractor shall use a transfer system to bring materials inside the building that is supplied by the Contractor. Contractor to ensure no damage to the overhead door, floor, facility or equipment.

I. Tools and Equipment

J. The Contractor shall be responsible to provide all tools and equipment necessary for a complete and satisfactory installation. All wheeled and rolling equipment used in the building during construction (after slab on grade has been poured) must use wheel wraps as drip diapers or similar to protect floor from rubber marking and equipment spillage of oil or other substances.

K. Construction, lifts, man Lifts and Vehicles

L. All wheeled and rolling equipment used in the building during construction (after slab on grade has been poured) must use wheel wraps as drip diapers or similar to protect floor from rubber marking and equipment spillage of oil or other substances.

M. Permits and Inspection

N. Contractor shall obtain, and pay for, all necessary permit fees and inspections required by the State or local municipalities.

O. Damaged Materials

P. Claims, due to freight damage, are the responsibility of Closed Industrial Vertical Tire Storage Carousel System Contractor. This includes any damage that is not evident at the time of the unloading of the equipment (i.e., concealed damage). Should such damage be uncovered, the Contractor must act promptly to repair/replace damaged equipment to minimize any delay to the schedule. Any added cost due to a delay is the responsibility of the Contractor.

Q. Debris Disposal

R. It shall be the responsibility of the Closed Industrial Vertical Tire Storage Carousel System Contractor to remove any debris resulting from his/her work on each and every workday to a pre-designated disposal area. This shall include all waste generated by the installer or any of his/her personnel, shipping containers, and/or construction materials. The Contractor shall broom clean the area each work day to leave the work area clean and allow the Owner access to scrub the floor. This will include organizing the materials not yet incorporated in the Work. At the completion of the work the Contractor shall remove all of his/her waste materials and rubbish from and about the project, as well as all his/her tools, construction equipment, machinery and surplus materials. The Contractor shall supply a list of excess materials to the Owner at the start of the project. Surplus materials, which have been paid for under the Contract Documents, shall remain in the possession of the Owner and will be banded and placed at locations specified by the Consultant or Owner. Surplus materials remaining on the site shall be bounded, bundled, or crated in such a manner that the materials can be easily and neatly stored and remain free from exposure to natural elements.

S. Clearance

T. The Contractor shall be responsible for maintaining all clearances specified on the drawings.

U. Modifications

V. The Contractor shall be responsible for the suitability of any Closed Industrial Vertical Tire Storage Carousel system component modifications required after installation begins. All modifications must be submitted and approved by the Owner and Consultant prior to beginning Work. Modifications done by others must be approved by the Contractor prior to modification. The Contractor shall be responsible for such a modification by others.

W. Contractor’s Survey of Damage

X. The Contractor shall conduct a survey of his/her work each and every workday morning and note any and all damages observed. Any damages must be reported to the General Contractor and the Owner by 9:00 a.m. Damages not reported within this time frame will be the contractor’s responsibility.

Y. Marking Restrictions

Z. Under no circumstances will a magic marker, sharpie or any other permanent marking device, which will absorb into concrete, paint or decking, be used for marking equipment locations. All markings must be water soluble and removable. The contractor is responsible to remove these markings prior to completing the Punch List

AA. Installation

BB. The Owner shall have the option of performing his/her own Vertical Tire Storage Carousel System installation.

3.02 FIELD PAINTING

A. Cleaning
   1. All surfaces to be painted must be thoroughly cleansed of rust, scale, oil, grease, dirt, welding flash and all other forms of dirt detrimental to good painting practices.

B. Touch-Ups

1. After the erection and installation are complete, the Contractor shall touch-up Vertical Tire Storage system components that were damaged or new welded surfaces using two (2) coats of lead-free paint. Finish to match factory finish.

END OF SECTION 10 56 29

This page intentionally left blank

SECTION 10 56 29.26
CANTILEVER STORAGE RACKS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Furnishing and installing cantilever storage rack as shown on the plans.

1.02 SUBMITTALS

A. Catalog cuts.

PART 2 PRODUCTS

2.01 MATERIALS

A. Racks shall be double sided, with shelf spacing at 4 feet vertically.

B. One rack shall be 16 feet long and 12 foot high; each arm shall be 4 feet long, at 4 foot minimum horizontal spacing. There shall be 3 shelves each side of the rack.

C. The other rack shall be 8 feet long and 8 feet high; each arm shall be 4 feet long, at 4 foot minimum horizontal spacing. There shall be 2 shelves each side of the rack

D. Each arm shall have a 500 pound minimum load capacity.

E. Wire deck material trays shall be furnished for half of the total horizontal ”shelf” space.

F. 75% of the arms shall have a 2 inch minimum tall vertical end lips; the remaining 25% of the arms shall have 6 inch minimum tall removable pipe end stops.

G. Vendors:
   1. Degraves (https://www.dcgraves.com/Heavy-Duty-Rack-s/1915.htm)
   2. Steel King (http://www.steelking.com/wp-content/uploads/2017/10/Cantilever_web.pdf)
   3. F.E. Bennett Co. (https://www.febennett.com/product/meco-heavy-duty-cantilever-rack-add-on-units/)
   4. Or approved equal.

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. For floor anchorage seismic calculations, reference general seismic design criteria note on Sheet S0.1. **The underlying floor slab shall be analyzed to determine what if any slab modifications need to be made.**

B. Install in accordance with and with manufacturer’s instructions at the location shown in the plans.

C. Install the wire deck material trays, cantilever arms with end lips, and cantilever arms with removable pipe stops at the locations on the rack and arms as directed by the Engineer.

END OF SECTION 10 56 29.26

This page intentionally left blank

SECTION 11 11 19
LUBE ROOM EQUIPMENT

PART 1 GENERAL

1.01 FURNISHED BY CONTRACTOR INSTALLED BY CONTRACTOR (FCIC)

A. Lube Room Equipment shall be Furnished by Contractor, Installed by Contractor (FCIC)

1.02 SYSTEM DESCRIPTION

A. Equipment item is listed below by Equipment I.D. Tag.

1. 300 Gal. Double Wall Oil Tank (Qty. 4)
   a. Equipment I.D. Tag: LR-02a 15w/40
   b. Equipment I.D. Tag: LR-02b 5w/20
   c. Equipment I.D. Tag: LR-02c Bio AW46
   d. Equipment I.D. Tag: LR-02d Future
2. 180 Gal. Double Wall Oil Tank. With SST inserts (Qty. 2)
   a. Equipment I.D. Tag: LR-06b Anti-Freeze
   b. Equipment I.D. Tag: LR-06a DEF
3. ¾" Air Diaphragm Pump 16 gpm (Qty. 1)
   a. Equipment I.D. Tag: LR-06b Anti-Freeze
4. ¾" Air Diaphragm Pump 15 gpm (Qty. 1)
   a. Equipment I.D. Tag: LR-06a DEF
5. Pump Wall Mount Brackets (to match air pumps) (Qty. 2)
   a. Equipment I.D. Tag: LR-06b Anti-Freeze
   b. Equipment I.D. Tag: LR-06a DEF
6. 6' Hose Dispensing Kit Suction/Discharge (to match air pumps) (Qty. 2)
   a. Equipment I.D. Tag: LR-06b Anti-Freeze
   b. Equipment I.D. Tag: LR-06a DEF
7. 1 X Close 304 SS Nipple (outlet valve) STOCK ITEM (Qty. 2)
   a. Equipment I.D. Tag: LR-06b Anti-Freeze
   b. Equipment I.D. Tag: LR-06a DEF
8. 1" SS Ball Valve STOCK ITEM (Qty. 2)
   a. Equipment I.D. Tag: LR-06b Anti-Freeze
   b. Equipment I.D. Tag: LR-06a DEF
9. ¾" SS King Nipple STOCK ITEM (Qty. 2)
   a. Equipment I.D. Tag: LR-06b Anti-Freeze
   b. Equipment I.D. Tag: LR-06a DEF
10. Graco 5:1 Fireball Pump – Universal (Qty. 6)
    a. Equipment I.D. Tag: LR-04a – LR-04b Transmission Fluid
    b. Equipment I.D. Tag: LR-02a 15w/40
    c. Equipment I.D. Tag: LR-02b 5w/20
    d. Equipment I.D. Tag: LR-02c Bio AW46
    e. Equipment I.D. Tag: LR-02d Future
11. ALE Filter Regulator with Auto Drain (1/4" MNPT) STOCK ITEM (Qty. 6)
    a. Equipment I.D. Tag: LR-04a – LR-04b Transmission Fluid
    b. Equipment I.D. Tag: LR-02a 15w/40
    c. Equipment I.D. Tag: LR-02b 5w/30
    d. Equipment I.D. Tag: LR-02c Bio AW46
    e. Equipment I.D. Tag: LR-02d Future
12. 5' PVC Pipe 1-1/4W/1ea / 1 ½ Male Adapter STOCK ITEM (Qty. 6)
    a. Equipment I.D. Tag: LR-04a – LR-04b Transmission Fluid
    b. Equipment I.D. Tag: LR-02a 15w/40
    c. Equipment I.D. Tag: LR-02b 5w/30
    d. Equipment I.D. Tag: LR-02c Bio AW46
    e. Equipment I.D. Tag: LR-02d Future
13. ½" x 15' hose STOCK ITEM (Qty. 2)

a. Equipment I.D. Tag: LR-04a – LR-04b Transmission Fluid

14. GRA Valve, EM8, Flex EXT ½" NPT STOCK ITEM (Qty. 2)
    a. Equipment I.D. Tag: LR-04a – LR-04b Transmission Fluid

B. HEAVY MAINTENANCE BAY
1. Oil Dispenser Bar w/ Digital flow Meters 2 Active 1 spare (Qty. 1)
    a. Equipment I.D. Tag: MB-12 - Antifreeze, DEF
2. Wall Mount Funnel for Collection of Used Oil (Qty. 1)
    a. Equipment I.D. Tag: MB-16

C. HOUSEHOLD HAZARD WASTE COLLECTION FACILTY
1. Wall Mount Funnel for Collection of Used Oil (Qty. 2)
    a. Equipment I.D. Tag: WH-01

D. Lube Room Equipment (s)
1. This section includes the specifications for the Lube Room Equipment (s) being installed for the dispensing of fluids in the shop areas as noted in the Bid Specifications and Bid Drawing Package.

E. Lube Room Equipment – Description of System(s)
1. The configurations for Lube Room are described below.
    a. Standalone equipment for Lube Room being installed for the dispensing of fluids for servicing on an assortment of Cars and Light / Heavy Duty Trucks.

F. Seismic Calculations
1. For seismic calculations, Reference general seismic design criteria noted on Sheet S0.1 Division 1 – General, A.9.

G. List of Applicable Forms
1. The General Conditions, Supplementary Conditions, Instructions to Bidders, Bid Form, all apply to these bid items.

1.03 DESCRIPTION OF WORK

A. List of Work
1. The extent of the Work is shown on the drawings and is defined to include (but not by way of limitations) all labor, materials, freight, unloading, equipment, taxes, permits and supervision required for equipment and installation.

B. Coordination
1. Contractor's Responsibility: It will be the Contractor's responsibility to verify and establish a detailed installation schedule.
2. Field Check: ALL BUILDING AND EQUIPMENT LAYOUT DIMENSIONS SHALL BE FIELD CHECKED AND VERIFIED BY CONTRACTOR PRIOR TO START OF INSTALLATION. NOTIFY THE CONSULTANT AND OWNER OF ANY DISCREPANCIES OR CONDITIONS AFFECTING MATERIALS AND/OR INSTALLATION WITHIN TEN (10) DAYS. IF A CONDITION EXISTS AND THE CONSULTANT OR OWNER IS NOT NOTIFIED THE ADDITIONAL COST TO CORRECT THE INSTALLATION IN ACCORDANCE WITH THE REQUIREMENTS OF THE OWNER WILL BE THAT OF THE CONTRACTOR.
3. Delivery and Unloading: The Lube Room Contractor shall be responsible for coordinating the delivery and unloading of the equipment to the job-site with the General Contractor to eliminate demurrage charges, unless authorized by the Owner or the Consultant. In order to eliminate disruption to the ongoing operations and prevent interference of dock access by trucks entering and leaving the site, temporary staging of materials will be provided outside of the building at a location designated by the Owner. The Lube Room Contractor shall provide storage facilities (i.e., covers, closed containers) to protect equipment from the elements (i.e., dust, dirt, rain, ice, snow, etc.) as necessary. Interior staging of equipment will be kept to a minimum so as not to disrupt ongoing operations.

1.04 QUALITY ASSURANCE

A. Standards

1. Equipment Standards: The equipment covered by these Specifications shall be designed, assembled, tested and installed in accordance with the latest applicable standards, including:
    a. American National Standards Institute (ANSI).
    b. International Building Code (IBC)
        1) International Building Code including current Building Code Amendments. (2015 Edition)
    c. Materials
        1) All materials furnished shall be new, free from defects, and UL-Approved where such approval is granted to the equipment to be furnished.
    d. Federal Inspection
        1) Latest published applicable Federal Specifications.
    e. OSHA
        1) Applicable OSHA Specifications.
    f. Building and Safety Codes
        1) Any applicable local building and safety codes pertaining to the Work.

B. Workmanship
1. Trade Methods: Use the best trade methods throughout. Work evidencing substandard workmanship shall be corrected or replaced by the Contractor at the Contractor's expense, per the General Conditions.
2. Touch Up Paint: The method for the touch up of paint shall follow specifications section 3.02 Field Painting.

C. Guarantees
1. WARRANTY:
    a. Warranty shall be the manufacturer's standard warranty and shall be specified by the Contractor in the contents of the proposal.
    b. The contractor shall provide an extended warranty for a period of three (3) years from Date of Acceptance.
    c. QUALITY OF MATERIALS AND EQUIPMENT: The Contractor guarantees the material and equipment delivered under the Contract to be free from defects in design or workmanship and against damages caused prior to final inspection. Unless otherwise specified, this guarantee extends for a period of three (3) years from the Date of Acceptance for both labor and materials.
    d. REPAIRING DEFECTS: The Contractor shall promptly repair or replace all defective or damaged items delivered under the Contract. The Lube Room Contractor may elect to have any replaced item returned to his/her plant at his/her expense.

1.05 SUBMITTALS

A. Product Data: Submit latest edition of Lube Room data sheet and outline drawing with the proposal.

B. Shop Drawings:
1. Shop Drawings, as stated in the General Conditions, shall include, but need not be limited to:
    a. Installation Plan: Proposed installation plan of equipment, including location and dimensions of new equipment clearly identified. It will be the Contractor's responsibility to verify and establish a detailed installation schedule per the General Conditions.
    b. Dimensions: Plan views showing all equipment dimensions along with any aisle clearance dimensions.
    c. Bill of Materials: Bill of Materials per the General Conditions.

C. Approved Shop Drawings
1. It will be the Contractor's responsibility to obtain approved shop drawings signed by the Consultant and/or Owner per the General Conditions prior to fabrication.

D. Manufacturer’s Reference:

1. Prime Manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

   Graco
   88-11th Avenue Northeast
   Minneapolis, MN 55413
   Phone: (612) 623-6000
   Website: https://www.graco.com/
   Lube Room DEF Pump Model: SD Blue Husky 515 15 gpm
   Lube Room Antifreeze Pump Model: 515/716 16 gpm
   Lube Room Oil Pump Model: 5:1 Fireball Universal Oil Pump

   Containment Solutions (300 gal. Tanks)
   333 North Rivershire Dr., Suite 190
   Conroe, TX 77304
   Phone: (936) 756-7731
   Website: https://www.containmentsolutions.com/
   Lube Room Oil Tank Model: UL-142 Double Wall Cube Tank w/ Spill box

   Snyder Industries, LLC (180 gal. Tanks)
   6940 O Street, Suite 100
   Lincoln, Nebraska 68510 USA
   Phone: (402) 467-5221
   Website: https://www.synderindustriestanks.com/
   Lube Room DEF Tank Model: ASM 180/180 Gravity Feed Cubetainer
   Lube Room Antifreeze Tank Model: ASM 180/180 Gravity Feed Cubetainer

   MECLUBE (Oil Despenser Bar)
   Strada Pavesa n.13, Loc. Bondeno
   Gonzaga, MN 46023 Italy
   Phone: 39 0376 595006
   Website: https://www.meclube.com/
   Oil Despenser Bar Model: 027-1342-c00 w/ Spill basin

   Mass Tank (Wall Mount Funnel for Collecting Waste Oil)
   29 Abbey Lane
   Middleboro, MA 02346
   Phone: 508-923-3445
   Website: https://www.wasteoiltanks.com/
   HOUSEHOLD HAZARD WASTE COLLECTION FACILTY
   Myers Aluminum Wall Mount Funnel Model: TTS-WALL-MOUNT 30” L x14” W
   VEHICLE SERVICE SHOP
   Myers Waste Oil Pumping Station Including:

Wall Mounted Funnel Assembly

Waste Oil Pumping Station

Tank End Pump Control Assembly

E. Other manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers may be considered as equal.

PART 2 PRODUCTS

2.01 LUBE ROOM EQUIPMENT GENERAL

A. The Contractor shall provide the following:
   1. List of Required Items
      a. New Lube Room as shown on the drawings, including freight, unloading, installation, touch-up painting, cleaning, and other equipment necessary to complete the system.

B. Quantity and Capacity
   1. See drawings for equipment location and configuration.

C. Standard Designs
   1. Components shall be of standard design and fabrication by the manufacturer so that all may be replaced or purchased at a future date without special charges or extended deliveries.

D. The Bill of Materials for this Work is to be determined by the Contractor from the bid drawings and contents of the Specifications. Lube Room Contractor to verify all information.

E. Codes
   1. The Lube Room shall be designed and installed to the exact standards of the manufacturer and in all cases shall conform to applicable codes.

F. Install
   1. The shipment of the Lube Room shall include all components to allow immediate install upon receipt.

G. Touch Up
   1. The Lube Room Contractor shall touch up any other Contractor's work damaged during the process per section 3.02 Field Painting.

2.02 LUBE ROOM

A. General: Equipment Tag # LR-02a, LR-02b, LR-02c, LR-02d 300 gal. Oil Tank(s) (Qty. 4)
   a. Description: Lube Room Tanks are typically used in commercial Vehicle Maintenance and Repair Shops for storing of oil to be dispensed out to the shop floor.
      1) Physical Data:
      2) Overall Dimensions:
         (a) Width: 3'-10"
         (b) Length: 3'-10"
         (c) Height: 4'-1"
      3) Capacity: 300 gal.
      4) Spare Port: 2"
      5) Fill Port: 2"
      6) Drain Port: ½"
      7) Vent Port: 2"
      8) Mech. Gauge Port: 2"
      9) Emergency Vent Port: 4"
      10) 2nd Emergency Vent Port: 4"
      11) 2nd Monitor Port: 2"
      12) 2nd Vent Port: 2"

2. Features and Construction:
   a. Spill Protection: Double Wall
   b. Spill Box: Included
   c. 2-year Manufacturer's warranty
3. Finish: Manufactures Standard

B. General: Equipment Tag # LR-06a, LR-06b 180 gal. Oil Tank(s) (Qty. 2)
   a. Description: Lube Room Tanks are typically used in commercial Vehicle Maintenance and Repair Shops for storing of oil to be dispensed out to the shop floor.
      1) Physical Data:
      2) Overall Dimensions:
      3) Width: 36"
      4) Length: 36"
      5) Height: 44"
      6) Capacity: 180 gal.
      7) Spare Port: 2"
      8) Fill/Dispensing Port: 2"
   2. Features and Construction:
      a. Spill Protection: Double Wall
      b. Site Gauge: Molded-In showing Gallons and Liters
      c. Spill Box: Included
      d. 2-year Manufacturer's warranty
   3. Finish: Manufactures Standard

C. General: Equipment Tag # LR-06b - ¾" Air Diaphragm Pump 16 gpm (Qty. 1)
   1. Description: Lube Room Pumps are typically used in commercial Vehicle Maintenance and Repair Shops for dispensing of oil out to the shop floor.
      a. Physical Data:
         1) Max. Fluid Pressure: 100 psi (6.9 bar)
         2) Max. Fluid Delivery: 16 gpm
         3) Max. Pump Speed: 400 cpm
         4) Max. Suction Lift: 15' dry, 25' wet
         5) Max. Ambient Temp.: 180d F
         6) Max. Diaphragm Temp.: 180d F
         7) Max. Air Consumption: 28 scfm
         8) Air inlet Size: ¼ NPT
         9) Fluid Inlet Size: ¾" NPT
         10) Fluid Outlet Size: ¾" NPT
   2. Features and Construction:
      a. Decibel Level: 77 dB(A) @70 psi Air/50 cpm
      b. Air Operating Range: 25 psi to 100 psi
      c. 2-year Manufacturer's warranty
   3. Finish: Manufactures Standard

D. General: Equipment Tag # LR-06a - ¾" Air Diaphragm Pump 15 gpm (Qty. 1)
   1. Description: Lube Room Pumps are typically used in commercial Vehicle Maintenance and Repair Shops for dispensing of oil out to the shop floor.
      a. Physical Data:
         1) Max. Fluid Pressure: 50 psi (3.5 bar)
         2) Max. Fluid Delivery: 15 gpm
         3) Max. Pump Speed: -
         4) Max. Suction Lift: 15' dry, 25' wet
         5) Max. Ambient Temp.: 180d F
         6) Max. Diaphragm Temp.: 180d F
         7) Max. Air Consumption: 28 scfm
         8) Air inlet Size: ¼ NPT
         9) Fluid Inlet Size: ¾" NPT

10) Fluid Outlet Size: ¾" NPT
11) Hose Outlet Size: ¾" NPT

2. Features and Construction:
   a. Decibel Level: 77 dB(A) @70 psi Air/50 cpm
   b. Air Operating Range: 30 psi to 50 psi
   c. 2-year Manufacturer's warranty
3. Finish: Manufactures Standard

E. General: Equipment Tag # (LR-02a, 2b, 2c, 2c) (LR-4a, 4b) – 5:1 Air Pump (Qty. 6)
1. Description: Lube Room Pumps are typically used in commercial Vehicle Maintenance and Repair Shops for dispensing of oil out to the shop floor.
   a. Physical Data:
      1) Fluid Pressure Ratio: 5:1
      2) Max. Fluid Pressure: 900 psi (62 bar)
      3) Max. Fluid Delivery: 12.1 gpm
      4) Output per Cycle: 133cc
      5) Max. Suction Lift: 15' dry, 25' wet
      6) Operating Air Pressure: 100 psi
      7) Operating Air Consumption: 28 scfm
      8) Air inlet Size: 3/8" NPT
      9) Fluid Inlet Size: 1-1/2" NPT
      10) Fluid Outlet Size: ½" NPT
      11) Working Pump Speed: 70 cpm
      12) Cycles per GAL.: 28.4
2. Features and Construction:
   a. Sound Pressure: 77.8 dB(A)
   b. Decibel Level: 85.6 dB(A)
   c. Air Operating Range: 40psi to 180 psi
   d. 2-year Manufacturer's warranty
3. Finish: Manufactures Standard

F. General: Equipment Tag # MB-12 Oil Dispensing Bar (Qty. 1)
1. Description: Oil Dispensing Bar are typically used in commercial Vehicle Maintenance and Repair Shops for delivery of fluids to be dispensed out to the shop floor.
   a. Physical Data:
      1) Overall Dimensions:
         (a) Width: 36"
         (b) Length: 36"
         (c) Height: 44"
   b. Fill/Dispensing Ports: 3
   c. Digital Flow Meter: 2 (covered future port)

G. General: Equipment Tag # MB-16, WH-01 Wall Mount Funnel for Waste Funnel (Qty. 2)
1. Description: Wall Mount Funnel for Waste Funnel are typically used in commercial Vehicle Maintenance and Repair Shops for receiving of waste fluids to be gravity feed out to tanks.
   a. Physical Data:
      1) Overall Dimensions:
         (a) Width: 14"
         (b) Length: 30"
         (c) Height: varies
   b. Product Data:
      1) Construction: 1/8" Aluminum Cover w/hinges
   c. Type: 30 Length /7 US. GAL.
   d. Accessories: Perforated Metal Screen

H. General: Equipment Tag # MB-17, Waste Oil Pumping System (Qty. 1)

1. Description: Wall Mount Funnel for Waste Funnel are typically used in commercial Vehicle Maintenance and Repair Shops for receiving of waste fluids to be feed out to tank.

Wall Mounted Funnel Assembly:

a.	Physical Data:	
	1) Overall Dimensions:	
	(a) Width:	- ”
	(b) Length:	- ”
	(c) Unit Depth:	23”
b.	Product Data:	
	1) Construction:	1/8” Steel Cover w/hinges
c.	Type:	35-liter capacity funnel assembly
d.	Accessories:	Lockable Cover Rubber Cover Seal Removable ¼” perforated filter plate Sludge Trap ¾” line fitting and ¾” non drip, male quick disconnects High Gloss Epoxy Paint ¾” pick-up wand with ¾” non-drip male quick disconnects. ¾” x 3’-0” sch.40 pipe stinger and wall bracket

Waste Oil Pump Station:

e.	Physical Data:	
	1) Overall Dimensions:	
	(a) Width:	15”
	(b) Length:	18”
	(c) Height:	25”
f.	Product Data:	
	1) Construction:	1/8” Steel High Gloss Epoxy Paint
g.	Pump:	¾” 100 psi air operated 16 gallon per min. Shock mounted control panel
h.	Air Controls:	Main air shut off valve Pressure control regulator and gauge Main air supply to pump on/off control valve operated by momentary pilot signal. Momentary control stop and start valves. Emergency high level sensing shut-off valve, c/w alarm and alarm air supply valve.
i.	Oil Line:	¾” sch, 40 piping and fittings c/w release valve for positive lock float valve
j.	Pick up Line:	¾” X 6’-0” flex suction hose complete with inline Strainer and non-grip female quick disconnect.
k.	Grounding:	3/8” ground lug and wing nut 6’-0” 14 ga. ground wire c/w bolt lug and drum clamp

Tank End Pump Control Assembly

l.	Product Data:	
	1) Construction:	1/8” Steel manhole cover to match existing tank Manhole. Full level positive lock, shut off float valve c/w with necessary pipe and fitting welded through manhole cover.

Emergency shut-down high-level spill tube signal generator c/w necessary pipe fitting.

PART 3 EXECUTION

3.01 EXAMINATION

A. Coordination
   1. Each Contractor must give careful consideration to the ongoing facility operations and the work of other contractors during the entire project and shall organize his/her work so that it will not interfere with ongoing operations or interfere with or delay the work of others. Minimal disruption to ongoing operations is a priority. It is imperative that the schedule be maintained with any changes coordinated promptly with the General Contractor, Owner, and Consultant.

B. General Description
   1. The Lube Room shall be installed complete in all details and in accordance with the specifications, manufacturer's recommendations, and the drawings.

C. Installation Routine
   1. Installation shall include unloading, checking and security of equipment prior to erection, shimming, complete anchoring, touch up and cleaning. The Contractor shall provide storage facilities (i.e., covers, closed containers) to protect equipment from the elements (i.e., dust, dirt, rain, snow, etc.). Contractor shall use a transfer system to bring materials inside the building that is supplied by the Contractor. Contractor to ensure no damage to the overhead door, floor, facility or equipment.

D. Tools and Equipment
   1. The Contractor shall be responsible to provide all tools and equipment necessary for a complete and satisfactory installation.

E. Permits and Inspection (as required)
   1. Contractor shall obtain, and pay for, all necessary permit fees and inspections required by the State or local municipalities.

F. Damaged Materials
   1. Claims, due to freight damage, are the responsibility of Lube Room Contractor. This includes any damage that is not evident at the time of the unloading of the equipment (i.e., concealed damage). Should such damage be uncovered, the Contractor must act promptly to repair/replace damaged equipment to minimize any delay to the schedule. Any added cost due to a delay is the responsibility of the Contractor.

G. Debris Disposal
   1. It shall be the responsibility of the Lube Room Contractor to remove any debris resulting from his/her work on each and every workday to a pre-designated disposal area. This shall include all waste generated by the installer or any of his/her personnel, shipping containers, and/or construction materials. The Contractor shall broom clean the area each work day to leave the work area clean and allow the Owner access to scrub the floor. This will include organizing the materials not yet incorporated in the Work. At the completion of the work the Contractor shall remove all of his/her waste materials and rubbish from and about the project, as well as all his/her tools.

H. Clearance
   1. The Contractor shall be responsible for maintaining all clearances specified on the drawings.

I. Modifications
   1. The Contractor shall be responsible for the suitability of any Lube Room component modifications required after installation begins. All modifications must be submitted and approved by the Owner and Consultant prior to beginning Work. Modifications done by others must be approved by the Contractor prior to modification. The Contractor shall be responsible for such a modification by others.

J. Contractor’s Survey of Damage

1. The Contractor shall conduct a survey of his/her work each and every workday morning and note any and all damages observed. Any damages must be reported to the General Contractor and the Owner by 9:00 a.m. Damages not reported within this time frame will be the contractor's responsibility.

K. Installation
1. The Owner shall have the option of performing his/her own Lube Room installation.

3.02 FIELD PAINTING

A. Cleaning
1. All surfaces to be painted must be thoroughly cleansed of rust, scale, oil, grease, dirt, welding flash and all other forms of dirt detrimental to good painting practices.

B. Touch-Ups
1. After the installations are complete, the Contractor shall touch-up any components that were damaged but only with owners/representative approval. Finish to match factory finish.

END OF SECTION 11 11 19

SECTION 11 11 23
TIRE CHANGER AND BALANCER EQUIPMENT

PART 1 GENERAL

1.01 FURNISHED BY CONTRACTOR INSTALLED BY CONTRACTOR (FCIC)

A. Tire Changer and Balancer Equipment shall be Furnished by Contractor, Installed by Contractor (FCIC)

1.02 SYSTEM DESCRIPTION

A. Equipment item is listed below by Equipment I.D. Tag.
   1. Tire Changer.
      a. Equipment I.D. Tag: TR-02 (Qty. 1)
   2. Tire Wheel Balancer.
      a. Equipment I.D. Tag: TR-03 (Qty. 1)
   3. Tire Changer and Balancing system(s)
      a. This section includes the specifications for the Tire Changer and Balancing system(s) being installed for removal/install and & balancing of tires in various sizes, weights, and areas as noted in the Bid Specifications and Bid Drawing Package.
   4. Tire Changer and Balancing system – Description of System(s)
      a. The configurations for tire changer and balancing equipment are described below.
         1) Standalone equipment for the removal and install along with the balancing of an assortment of tires typical in shop use.

B. For seismic calculations, Reference general seismic design criteria noted on Sheet S0.1 Division 1 – General, A.9

C. List of Applicable Forms
   1. The General Conditions, Supplementary Conditions, Instructions to Bidders, Bid Form, all apply to these bid items.

1.03 DESCRIPTION OF WORK

A. List of Work
   1. The extent of the Work is shown on the drawings and is defined to include (but not by way of limitations) all labor, materials, freight, unloading, equipment, taxes, permits and supervision required for the equipment and installation. The Tire Changing and Balancing Equipment shall include all materials necessary for the desired performance.

B. Coordination
   1. Contractor’s Responsibility: It will be the Contractor's responsibility to verify and establish a detailed installation schedule.
   2. Field Check: ALL BUILDING AND EQUIPMENT LAYOUT DIMENSIONS SHALL BE FIELD CHECKED AND VERIFIED BY CONTRACTOR PRIOR TO START OF INSTALLATION. NOTIFY THE CONSULTANT AND OWNER OF ANY DISCREPANCIES OR CONDITIONS AFFECTING MATERIALS AND/OR INSTALLATION WITHIN TEN (10) DAYS. IF A CONDITION EXISTS AND THE CONSULTANT OR OWNER IS NOT NOTIFIED THE ADDITIONAL COST TO CORRECT THE INSTALLATION IN ACCORDANCE WITH THE REQUIREMENTS OF THE OWNER WILL BE THAT OF THE CONTRACTOR.
   3. Delivery and Unloading: The Tire Changing and Balancing Equipment System Contractor shall be responsible for coordinating the delivery and unloading of the equipment to the job-site with the General Contractor to eliminate demurrage charges, unless authorized by the Owner or the Consultant. In order to eliminate disruption to the ongoing operations and prevent interference of dock access by trucks entering and leaving the site, temporary staging of materials will be provided outside of the building at a location designated by the Owner. The Tire Changing and Balancing Equipment System Contractor shall provide storage facilities (i.e. covers, closed containers) to protect equipment from the elements (i.e. dust, dirt, rain, ice, snow, etc.) as necessary. Interior staging of equipment will be kept to a minimum so as not to disrupt ongoing operations.

C. QUALITY ASSURANCE

1. Standards
    a. Equipment Standards: The equipment covered by these Specifications shall be designed, assembled, tested and installed in accordance with the latest applicable standards, including:
    b. American National Standards Institute (ANSI).
    c. International Building Code (IBC)
        1) International Building Code including current Building Code Amendments. (2015 Edition)
    d. Materials
        1) All materials furnished shall be new, free from defects, and UL-Approved where such approval is granted to the equipment to be furnished.
    e. Federal Inspection
        1) Latest published applicable Federal Specifications.
    f. OSHA
        1) Applicable OSHA Specifications.
    g. Building and Safety Codes
    h. Any applicable local building and safety codes pertaining to the Work.

D. Workmanship
1. Trade Methods: Use the best trade methods throughout. Work evidencing substandard workmanship shall be corrected or replaced by the Contractor at the Contractor's expense, per the General Conditions.
2. Touch Up Paint: The method for the touch up of paint shall follow specifications section 3.02 Field Painting.

E. Guarantees
1. WARRANTY:
    a. Warranty shall be the manufacturer's standard warranty and shall be specified by the Contractor in the contents of the proposal.
    b. The contractor shall provide an extended warranty for a period of three (3) years from Date of Acceptance.

F. QUALITY OF MATERIALS AND EQUIPMENT: The Contractor guarantees the material and equipment delivered under the Contract to be free from defects in design or workmanship and against damages caused prior to final inspection. Unless otherwise specified, this guarantee extends for a period of three (3) years from the Date of Acceptance for both labor and materials.

G. REPAIRING DEFECTS: The Contractor shall promptly repair or replace all defective or damaged items delivered under the Contract. The Tire Changing and Balancing equipment Contractor may elect to have any replaced item returned to his/her plant at his/her expense.

1.04 SUBMITTALS

A. Product Data: Submit latest edition of Tire Changing and Balancing equipment data sheet and outline drawing with the proposal.
1. Shop Drawings:
    a. Shop Drawings, as stated in the General Conditions, shall include, but need not be limited to:
    b. Installation Plan: Proposed installation plan of equipment, including location and dimensions of new equipment clearly identified. It will be the Contractor's responsibility to verify and establish a detailed installation schedule per the General Conditions.
    c. Dimensions: Plan views showing all equipment dimensions along with any aisle clearance dimensions.
    d. Bill of Materials: Bill of Materials per the General Conditions.

B. Approved Shop Drawings
1. It will be the Contractor's responsibility to obtain approved shop drawings signed by the Consultant and/or Owner per the General Conditions prior to fabrication.

C. Manufacturer’s Reference:

1. Prime Manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

   Hunter Engineering Company

   11250 Hunter Dr.

   Bridgeton, MO 63044

   Phone: (314) 731-0000

   Website: https://www.hunter.com/

   Tire Changer Model: TCX5xH

   Tire Balancer Model: HDE-11

D. Other manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers may be considered as equal.

PART 2 PRODUCTS

2.01 TIRE CHANGER AND WHEEL BALANCING EQUIPMENT GENERAL

A. The Contractor shall provide the following:
   1. List of Required Items
      a. New Tire Changing and Balancing Equipment system as shown on the drawings, including freight, unloading, installation, touch-up painting, cleaning, and other equipment necessary to complete the system.

B. Quantity and Capacity
   1. See drawings for equipment location and configuration.

C. Standard Designs
   1. Components shall be of standard design and fabrication by the manufacturer so that all may be replaced or purchased at a future date without special charges or extended deliveries.
   2. The Bill of Materials for this Work is to be determined by the Contractor from the bid drawings and contents of the Specifications. Tire Changing and Balancing Equipment Contractor to verify all information.

D. Codes
   1. The Tire Changing and Balancing Equipment system shall be designed and installed to the exact standards of the manufacturer and in all cases shall conform to applicable codes.

E. Loads and Capacity
   1. The Tire Changing and Balancing Equipment System shall be designed to handle loads under normal, impact loading conditions experienced in a manual tire loading application.

F. Install
   1. The shipment of the Tire Changing and Balancing Equipment shall include all components to allow immediate install upon receipt.

G. Anchoring
   1. All work must be rigid and anchored securely, use 1/2" through bolts and lock nuts. Method of attachment to be approved prior to installation.

H. Anchor Holes
   1. All anchor holes are to be vacuum cleaned at time of drilling.

I. Touch Up
   1. The Tire Changing and Balancing Equipment Contractor shall touch up any other Contractor’s work damaged during the process per section 3.02 Field Painting.

2.02 TIRE CHANGING AND BALANCING EQUIPMENT

1. General: Equipment Tag # TR-02 Tire Changer (Qty. 1)

a. Description: Tire Changing Equipment unit used in commercial Vehicle Maintenance and Repair Shops.
   1) Physical Data:
      (a) Overall Dimensions:
         (1) Width: 55”
         (2) Depth: 47”
         (3) Height: 62”
b. Rim Diameter Range: 10-26” external / 12-28” Internal
c. Max. Tire diameter: 46”
d. Max Tire width: 14”
e. Power Requirements: 208-230V, 6A, 50/60 Hz 1ph
f. Plug Type: L6-20P
g. Air Requirements: 110-145 psi (8-10 bar)

2. Features and Construction:
   a. Plastic Mount Head (w/protection)
   b. Manual Swing Arm
   c. Power Out Side Shovel
   d. 2 -year Manufacturer’s warranty
3. Finish: Manufactures Standard

B. General: **Equipment Tag # TR-03 Tire Balancer (Qty. 1)**
1. Description: Tire Balancing Equipment unit used in commercial Vehicle Maintenance and Repair Shops.
   a. Physical Data:
      1) Overall Dimensions:
      2) Width: 75.75”
      3) Depth: 73.5”
      4) Height: 80.5”
2. Rim Width Range: 1.5” to 19.5”
3. Rim Diameter Range: 10” to 30”
4. ALU: 7.5” to 38”
5. Max. Tire diameter: 52”
6. Max Tire width: 25”
7. Max Tire weight: 500 lbs.
8. Imbalance Resolution: +/- 0.05 oz
9. Placement Accuracy: 512 Positions, +/- 0.35 degrees
10. Balancing Speed: 100 rpm
11. Power Requirements: 196-253V, 10A, 50/60 Hz 1ph
12. Plug Type: L6-20P
13. Air Requirements: 100-175 psi (7-12 bar)
14. Air Consumption: 4 CFM

C. Features and Construction:
1. Ink Jet Printer with Storage
2. Programmable drive system with DC motor
3. Finish: Manufactures Standard

PART 3 EXECUTION

3.01 EXAMINATION

A. Coordination
1. Each Contractor must give careful consideration to the ongoing facility operations and the work of other contractors during the entire project and shall organize his/her work so that it will not interfere with ongoing operations or interfere with or delay the work of others. Minimal disruption to ongoing operations is a priority. It is imperative that the schedule be maintained with any changes coordinated promptly with the General Contractor, Owner, and Consultant.

B. General Description
   1. The Tire Changing and Balancing Equipment System shall be installed true and properly aligned complete in all details and in accordance with the specifications, manufacturer's recommendations, and the drawings.

C. Installation Routine
   1. Installation shall include unloading, checking and security of equipment prior to erection, shimming, complete anchoring, touch up and cleaning. The Contractor shall provide storage facilities (i.e. covers, closed containers) to protect equipment from the elements (i.e. dust, dirt, rain, snow, etc.). Contractor shall use a transfer system to bring materials inside the building that is supplied by the Contractor. Contractor to ensure no damage to the overhead door, floor, facility or equipment.

D. Tools and Equipment
   1. The Contractor shall be responsible to provide all tools and equipment necessary for a complete and satisfactory installation. All wheeled and rolling equipment used in the building during construction (after slab on grade has been poured) must use wheel wraps or similar to protect floor from rubber.

E. Permits and Inspection
   1. Contractor shall obtain, and pay for, all necessary permit fees and inspections required by the State or local municipalities.

F. Damaged Materials
   1. Claims, due to freight damage, are the responsibility of Tire Changing and Balancing Equipment System Contractor. This includes any damage that is not evident at the time of the unloading of the equipment (i.e. concealed damage). Should such damage be uncovered, the Contractor must act promptly to repair/replace damaged equipment to minimize any delay to the schedule. Any added cost due to a delay is the responsibility of the Contractor.

G. Debris Disposal
   1. It shall be the responsibility of the Tire Changing and Balancing Equipment System Contractor to remove any debris resulting from his/her work on each and every workday to a pre-designated disposal area. This shall include all waste generated by the installer or any of his/her personnel, shipping containers, and/or construction materials. The Contractor shall broom clean the area each work day to leave the work area clean and allow the Owner access to scrub the floor. This will include organizing the materials not yet incorporated in the Work. At the completion of the work the Contractor shall remove all of his/her waste materials and rubbish from and about the project, as well as all his/her tools, construction equipment, machinery.

H. Clearance
   1. The Contractor shall be responsible for maintaining all clearances specified on the drawings.

I. Modifications
   1. The Contractor shall be responsible for the suitability of any Tire Changing and Balancing Equipment system component modifications required after installation begins. All modifications must be submitted and approved by the Owner and Consultant prior to beginning Work. Modifications done by others must be approved by the Contractor prior to modification. The Contractor shall be responsible for such a modification by others.

J. Contractor’s Survey of Damage
   1. The Contractor shall conduct a survey of his/her work each and every workday morning and note any and all damages observed. Any damages must be reported to the General Contractor and the Owner by 9:00 a.m. Damages not reported within this time frame will be the contractor’s responsibility.

K. Marking Restrictions
   1. Under no circumstances will a magic marker, sharpie or any other permanent marking device, which will absorb into concrete, paint or decking, be used for marking equipment

locations. All markings must be water soluble and removable. The contractor is responsible to remove these markings prior to completing the Punch List

L. Installation
   1. The Owner shall have the option of performing his/her own Tire Changing and Balancing Equipment System installation.

3.02 FIELD PAINTING

A. Cleaning
   1. All surfaces to be painted must be thoroughly cleansed of rust, scale, oil, grease, dirt, welding flash and all other forms of dirt detrimental to good painting practices.

B. Touch-Ups
   1. After the installations are complete, the Contractor shall touch-up any components that were damaged but only with owners/representative approval. Finish to match factory finish.

END OF SECTION 11 11 23

SECTION 11 13 19
STATIONARY LOADING DOCK EQUIPMENT

PART 1 GENERAL

1.01 FURNISHED BY CONTRACTOR INSTALLED BY CONTRACTOR (FCIC)

A. Stationary Loading Dock Equipment shall be Furnished by Contractor, Installed by Contractor (FCIC).

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.03 SYSTEM DESCRIPTION

A. Equipment items as listed below by Equipment Tag Number:
   1. Recessed loading dock levelers with dock bumpers.
      a. Hazard Waste Recycle Bldg. Equipment Tag LD-01 (2 qty)
         1) Recessed Loading Dock:
         2) This section includes the specifications for Recessed Loading Dock Levelers that are being installed for the transfer of material of various sizes and weights from trailer to loading dock as noted in the Bod Specifications and Bid Drawing Package.
      b. Recessed Loading Dock – Description of System (s)
         1) Standalone Equipment for the transfer of pallets of material of various sizes and weights from trailer to loading dock

B. Equipment items as listed below by Equipment Tag Number:
   1. Snow Plow install/removal wall protection bumpers.
      a. Medium to Large Covered Packing Structure. Equipment Tag SP-02 (15 qty)
      b. Protection bumpers:
         1) Extra length loading dock bumpers as noted in the Bod Specifications and Bid Drawing Package.
         2) Wall Protection Bumpers – Description of System (s)
            (a) Standalone Equipment for wall protection against potential unintentional impact during install or removal of the snow plows with the overhead crane.

1.04 REFERENCES

A. Section 055000 "Metal Fabrications" for curb angles at edges of recessed pits and loading dock platform edge channels.

1.05 DEFINITIONS

A. Operating Range: Maximum amount of travel above and below the loading dock level.

B. Working Range: Recommended amount of travel above and below the loading dock level for which loading and unloading operations can take place.

1.06 COORDINATION

A. Coordinate size and location of loading dock equipment indicated to be attached to or recessed into concrete, and furnish anchoring devices with templates, diagrams, and instructions for their installation

B. Coordinate installation of cast-in-place items. Furnish setting drawings and templates.

C. Electrical System Roughing-in: Coordinate layout and installation of loading dock equipment with connections to power supplies and interlocked equipment.

1.07 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
   2. Review sequence of operation for each type of loading dock equipment.
   3. Review coordination of interlocked equipment specified in this Section and elsewhere.

4. Review required testing, inspecting, and certifying procedures.

1.08 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for stationary loading dock equipment.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For stationary loading dock equipment. Including safety barrier.
1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of anchors and each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Engineering for dock safety barrier certifying barrier capacity.

1.09 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installers of each product.

B. Welding certificates.

C. Product Test Reports: For each dock leveler, for tests performed by manufacturer and witnessed by a qualified testing agency.
1. Indicate compliance of dock levelers with requirements in MH 30.1 for determining rated capacity based on comprehensive testing within last two years of current products.
2. Submittal Form: According to MH 30.1.

D. Sample Warranty: For manufacturer's special warranty.

1.10 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For stationary loading dock equipment to include in operation and maintenance manuals.

1.11 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.12 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with stationary loading dock equipment, including recessed pit dimensions, slopes of driveways, and heights of loading docks, by field measurements before fabrication.

1.13 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace dock levelers that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Structural failures including cracked or broken structural support members, load-bearing welds, and front and rear hinges.
b. Faulty operation of operators, control system, or hardware.
c. Deck plate failures including cracked plate or permanent deformation in excess of 1/8 inch between deck supports.
2. Hydraulic system failures including failure of hydraulic seals and cylinders.

B. Warranty Period for Structural Assembly: One year from date of Substantial Completion.

C. Warranty Period for Hydraulic System: One year from date of Substantial Completion.

D. Warranty shall be for unlimited usage of leveler for the specified rated capacity over the term of the warranty.

PART 2 PRODUCTS

2.01 RECESSED LOADING DOCK LEVELERS – HAZARD WASTE RECYCLING BLDG. – EQPM TAG #LD-01 (2 QTY)

A. General: Recessed, hinged-lip-type dock levelers designed for permanent installation in concrete pits preformed in the edge of loading platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.

B. Basis of Design: Blue Giant Equipment Corporation; Model H Series.
   1. Other Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Beacon Industries, Inc.
      b. Kelley; An Entrematic brand.
      c. McGuire; A Division of Systems, Inc.
      d. Rite-Hite Corporation
   2. Or substitute as approved by Owner.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Standard: Comply with MH 30.1.

E. Rated Capacity: Capable of supporting total gross load of 33,000 lbs. without permanent deflection or distortion.

F. Platform: Nonskid steel plate.
   1. Platform Width: 84 inches.
   2. Platform Length: 72 inches.
   3. Frame: Manufacturer's standard.
   4. Toe Guards: Equip open sides of dock leveler over range indicated with steel toe guards.
      a. Toe-Guard Range: Entire upper operating range.

G. Hinged Lip: Nonskid steel plate.
   1. Hinge: Full-width, piano-type hinge with heavy-wall hinge tube and grease fittings, with gussets on lip and ramp for support.
   2. Safety Barrier Lip: Designed to protect material-handling equipment from an accidental fall from loading platform edge of the dock leveler when the leveler is not in use.

H. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.
   1. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:
      a. Above Adjoining Platform: 12 inches.
      b. Below Adjoining Platform: 12 inches.
   2. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
   3. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 4 inches over width of ramp.
   4. Lip Operation: Manufacturer's standard mechanism, which automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck and automatically retracts lip when truck departs.
      a. Length of Lip Extension: Not less than 12 inches from face of dock bumpers and not less than 16 inches measured from ramp edge.
   5. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs.

I. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Include means for lowering ramp below platform level with lip retracted behind dock bumpers. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 inches.

1. Remote-Control Station with Emergency Stop: Weatherproof multi-button control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, Type 4 box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. Ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.

J. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.

1. Cross-Traffic Support: Manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
2. Maintenance Strut: Integral strut to positively support ramp in up position during maintenance of dock leveler.

K. Integral Laminated-Tread Dock Bumpers: Fabricated from 4-1/2-inch-thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch-diameter, steel supporting rods that are welded at one end to 1/4-inch-thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch of tread plies extending beyond the face of closure angles.

L. Materials:

1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from steel plate complying with ASTM A572/A572M, Grade 55.
3. Steel Tubing: ASTM A500/A500M, cold formed.
4. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

M. Dock-Leveler Finish: Manufacturer's standard baked-on powder coat factory finish.

N. Accessories: Side and rear rubber weather seals.

2.02 DOCK SAFETY BARRIER

A. General: Manually operated safety barrier for pedestrian and forklift safety at dock edge.

1. Basis of Design: Dock-Guardian LD Safety Barrier
   a. Height: 44”
2. Material: PVC fiberglass mesh curtain

B. FINISH REQUIREMENTS

1. Finish loading dock equipment after assembly and testing.
2. Hot-Dip Galvanizing: Comply with the following:
   a. ASTM A123/A123M for iron and steel loading dock equipment.
   b. ASTM A153/A153M or ASTM F2329/F2329M for iron and steel hardware for loading dock equipment.

C. Electrodeposited Zinc Coatings: ASTM B633.

D. Baked-on Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

1. Color: Selected by Owner from manufacturer’s full line.

2. Toe Guards: Paint to comply with ANSI Z535.1.

2.03 SNOW PLOW INSTALL/REMOVAL WALL PROTECTION BUMPERS (15 QTY)

A. General: Box Truck Dock Bumpers.
1. Basis of Design: Morgan Box Truck Bumpers
   a. Width: 24”
   b. Depth: 3”
   c. Height: 3”
2. Material: Rubber

B. Anchoring holes: 4

C. Anchoring Requirements: Standard ½”-13 x 6” anchor bolts

D. FINISH REQUIREMENTS
1. Manufacture Finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical systems for loading dock equipment to verify actual locations of connections before equipment installation.

C. Examine walls and floors of pits for suitable conditions where recessed loading dock equipment is to be installed. Pits shall be plumb and square and properly sloped for drainage from back to front of loading dock.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Retain first paragraph below if retaining curb angles in this Section.

B. Clean recessed pits of debris.

3.03 INSTALLATION, GENERAL

A. Install loading dock equipment as required for a complete installation.
1. Rough-in electrical connections.

B. **INSTALLATION OF RECESSED LOADING DOCK LEVELERS**
1. Attach dock levelers securely to loading dock platform, flush with adjacent loading dock surfaces and square to recessed pit.

C. **INSTALLATION OF DOCK BARRIER**
1. Install per manufacturer’s written instructions by installer qualified by the manufacturer.

D. **ADJUSTING**
1. Adjust loading dock equipment to function smoothly and safely and lubricate as recommended by manufacturer.
2. Test dock levelers for vertical travel and adjust to maintain operating range indicated.
3. After completing installation of exposed, factory-finished loading dock equipment, inspect exposed finishes and repair damaged finishes.

3.04 MAINTENANCE SERVICE

A. Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of loading dock equipment Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper loading dock equipment operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain loading dock equipment.

END OF SECTION 11 13 19

This page intentionally left blank

SECTION 11 30 13
APPLIANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Kitchen appliances.

B. Laundry appliances.

1.02 REFERENCE STANDARDS

A. UL (DIR) - Online Certifications Directory Current Edition.

1.03 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of equipment specified.

C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Contracting Agency's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).

1.05 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.

C. Provide ten (10) year manufacturer warranty on magnetron tube of microwave ovens.

D. Provide ten (10) year manufacturer warranty on tub and door liner of dishwashers.

PART 2 PRODUCTS

2.01 MAUFACTURERS

A. Whirlpool Corporation: www.whirlpool.com/#sle.

B. GE Appliances: www.geappliances.com/#sle.

C. Kenmore: www.kenmore.com/#sle

D. Substitutions: See Section 1-06.7.

2.02 KITCHEN APPLIANCES

A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.

B. Refrigerator, Type REFR-1: Free-standing, top-mounted freezer, and frost-free.
   1. Basis of Design Manufacturer and Product: GE GIE19JSNRSS
   2. Capacity: Total minimum storage of 19.2 cubic ft (0.54 cu m); minimum 25 percent freezer capacity.
   3. Features:
      a. ADA Compliant.
      b. ENERGY STAR® Certified.
      c. Deli Drawer.
      d. Spillproof Freezer Floor.
      e. Upfront Controls.
      f. LED Lighting.
      g. Never Clean Condenser.
      h. Icemaker.
      i. Edge-to-edge Glass Shelves.
   4. Exterior Finish: Stainless Steel

C. Refrigerator, Type REFR-2: Free-standing, side-by-side, and frost-free.
   1. Basis of Design Manufacturer and Product: GE GFE28GYNFS
   2. Capacity: Total minimum storage of 27.7 cubic ft (0.78 cu m); minimum 25 percent freezer capacity.
   3. Features:
      a. ADA compliant.
      b. ENERGY STAR® certified.
      c. Glass adjustable spill-proof shelves.
      d. Twinchill evaporators.
      e. Automatic icemaker.
      f. Through door water and ice dispenser.
      g. Showcase LED lighting.
      h. Turbo cool setting.
      i. Door alarm.
      j. UL certification.
      k. Child safety lock.
      l. Exterior electronic touch controls.
      m. CSA certified.
      n. Fingerprint-proof.
      o. Adjustable door bins.
      p. Quick freeze.
      q. Digital temperature controls.
   4. Exterior Finish: Stainless steel
   5. Exterior Finish: Stainless steel.

D. Microwave: Countertop.
   1. Basis of Design Manufacturer and Product: GE JES1657SMSS
   2. Capacity: 1.6 cubic ft (0.04 cu m).
   3. Power: 1150 watts.
   4. Features:
      a. Turntable.
      b. Light.
      c. Sensor cooking.
      d. Weight and time defrost .
      e. 10 power levels.
      f. Add 30 seconds.
      g. Timer.
      h. Control lock.
      i. Touch controls in stainless steel.
   5. Exterior Finish: Stainless steel.

E. Dishwasher: Undercounter.
   1. Basis of Design Manufacturer and Product: Whirlpool WDF550SAH
   2. Controls: Solid state electronic.
   3. Wash Levels: Three (3).
   4. Cycles: Six (6), including normal, rinse and hold, short, china/crystal, and pot and pan.
   5. Features:
      a. ENERGY STAR® Certified.
      b. ADA compliant
      c. 12 place petting capacity
      d. 5 cycles
      e. 4 options
      f. Stainless steel tub
      g. Full console controls
      h. 51 dBA noise level
      i. Energy Star certified

j. Heated dry option
k. Delay start
l. Quick wash
m. Adjustable upper rack
n. Control lock

6. Exterior Finish: Stainless steel .

2.03 LAUNDRY APPLIANCES

A. Commercial Clothes Washer: Front-loading.
1. Basis of Design Manufacturer and Product: Whirlpool CHW9160GW
2. Size: 3.1 cubic foot capacity.
3. Certifications: ENERGY STAR® certified.
4. Controls: Solid state electronic.
5. Finish: Painted steel, color white.
6. Drum: Stainless steel.
7. Warranty: Two year limited parts.

B. Commercial Clothes Dryer: Electric, stationary.
1. Basis of Design Manufacturer and Product: Whirlpool CED9160GW.
2. Size: 6.7 cubic foot capacity
3. Controls: Solid state electronic.
4. Temperature Selections: Three.
5. Cycles: Include three dry cycles.
6. Features: Include reversible door.
7. Finish: Painted steel, color white.
8. Warranty: Two year limited parts.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify utility rough-ins are provided and correctly located.

3.02 INSTALLATION

A. Confirm electrical manufacturers electrical and plumbing requirements have been provided before installation

B. Install in accordance with manufacturer's instructions.

C. Anchor built-in equipment in place.

D. Protect appliances until Substantial Completion.

3.03 ADJUSTING

A. Adjust equipment to provide efficient operation.

3.04 CLEANING

A. Remove packing materials from equipment and properly discard.

B. Wash and clean equipment.

END OF SECTION 11 30 13

This page intentionally left blank

SECTION 11 50 00
SHOP EQUIPMENT

PART 1 GENERAL

1.01 FURNISHED BY CONTRACTOR INSTALLED BY CONTRACTOR (FCIC)

A. Shop Equipment shall be Furnished by Contractor, Installed by Contractor (FCIC)

1.02 SYSTEM DESCRIPTION

A. Equipment item is listed below by Equipment I.D. Tag.

1. Shop Heavy Duty Work Bench.
   a. Equipment I.D. Tag: MB-14 (Qty. 4)
2. Lubrication Trolley.
   a. 85/90 Oil Trolley Equipment I.D. Tag: LR-05a (Qty. 1)
   b. Grease Trolley Equipment I.D. Tag: LR-05b (Qty. 1)
3. Industrial Mobile Computer Cart.
   a. Equipment I.D. Tag: MB-15 (Qty. 1)

B. Shop Equipment
   1. This section includes the specifications for Shop Equipment that are being installed for the servicing of vehicles of various sizes and weights, as noted in the Bid Specifications and Bid Drawing Package.
   2. Shop Equipment – Description of System(s)
      a. The configurations for Shop Equipment are described below.
         1) Miscellaneous Shop Equipment for the servicing of vehicles on an assortment of Cars and Light / Heavy Duty Trucks.

C. Seismic Calculations
   1. For seismic calculations, Reference general seismic design criteria noted on Sheet S0.1 Division 1 – General, A.9.

D. List of Applicable Forms
   1. The General Conditions, Supplementary Conditions, Instructions to Bidders, Bid Form, all apply to these bid items.

1.03 DESCRIPTION OF WORK

A. List of Work
   1. The extent of the Work is shown on the drawings and is defined to include (but not by way of limitations) all labor, materials, freight, unloading, equipment, taxes, permits and supervision required for equipment and installation.

B. Coordination
   1. Contractor’s Responsibility: It will be the Contractor's responsibility to verify and establish a detailed installation schedule.

C. Field Check: ALL BUILDING AND EQUIPMENT LAYOUT DIMENSIONS SHALL BE FIELD CHECKED AND VERIFIED BY CONTRACTOR PRIOR TO START OF INSTALLATION. NOTIFY THE CONSULTANT AND OWNER OF ANY DISCREPANCIES OR CONDITIONS AFFECTING MATERIALS AND/OR INSTALLATION WITHIN TEN (10) DAYS. IF A CONDITION EXISTS AND THE CONSULTANT OR OWNER IS NOT NOTIFIED THE ADDITIONAL COST TO CORRECT THE INSTALLATION IN ACCORDANCE WITH THE REQUIREMENTS OF THE OWNER WILL BE THAT OF THE CONTRACTOR.

D. Delivery and Unloading: The Shop Equipment Contractor shall be responsible for coordinating the delivery and unloading of the equipment to the job-site with the General Contractor to eliminate demurrage charges, unless authorized by the Owner or the Consultant. In order to eliminate disruption to the ongoing operations and prevent interference of dock access by trucks entering and leaving the site, temporary staging of materials will be provided outside of the building at a location designated by the Owner. The Shop Equipment Contractor shall provide storage facilities (i.e., covers, closed containers) to protect equipment from the

elements (i.e., dust, dirt, rain, ice, snow, etc.) as necessary. Interior staging of equipment will be kept to a minimum so as not to disrupt ongoing operations.

1.04 QUALITY ASSURANCE

A. Standards
   1. Equipment Standards: The equipment covered by these Specifications shall be designed, assembled, tested and installed in accordance with the latest applicable standards, including:
   2. American National Standards Institute (ANSI).
   3. American Iron and Steel Institute.
      a. Specification for Design of Cold-Formed Steel Association - "Structural Members" 2015 edition.
   4. International Building Code (IBC)
      a. International Building Code including current Building Code Amendments. (2015 Edition)
   5. Seismic Zone
      a. The seismic zone for the project is Seismic Zone 3 with near source distance factors applied.
   6. Materials
      a. All materials furnished shall be new, free from defects, and UL-Approved where such approval is granted to the equipment to be furnished.
   7. Federal Inspection
      a. Latest published applicable Federal Specifications.
   8. OSHA
      a. Applicable OSHA Specifications.
   9. Building and Safety Codes
      a. Any applicable local building and safety codes pertaining to the Work.

B. Workmanship
   1. Trade Methods: Use the best trade methods throughout. Work evidencing substandard workmanship shall be corrected or replaced by the Contractor at the Contractor's expense, per the General Conditions.

C. Touch Up Paint: The method for the touch up of paint shall follow specifications section 3.02 Field Painting.

D. Guarantees
   1. WARRANTY:
      a. Warranty shall be the manufacturer's standard warranty and shall be specified by the Contractor in the contents of the proposal.
      b. The contractor shall provide an extended warranty for a period of three (3) years from Date of Acceptance.

E. QUALITY OF MATERIALS AND EQUIPMENT: The Contractor guarantees the material and equipment delivered under the Contract to be free from defects in design or workmanship and against damages caused prior to final inspection. Unless otherwise specified, this guarantee extends for a period of three (3) years from the Date of Acceptance for both labor and materials.

F. REPAIRING DEFECTS: The Contractor shall promptly repair or replace all defective or damaged items delivered under the Contract. The Shop Equipment Contractor may elect to have any replaced item returned to his/her plant at his/her expense.

1.05 SUBMITTALS

A. Product Data: Submit latest edition of Shop Equipment data sheet and outline drawing with the proposal.
   1. Shop Drawings:
      a. Shop Drawings, as stated in the General Conditions, shall include, but need not be limited to:

2. Installation Plan: Proposed installation plan of equipment, including location and dimensions of new equipment clearly identified. It will be the Contractor's responsibility to verify and establish a detailed installation schedule per the General Conditions.
3. Dimensions: Plan views showing all equipment dimensions along with any aisle clearance dimensions.
4. Bill of Materials: Bill of Materials per the General Conditions.

B. Approved Shop Drawings
1. It will be the Contractor's responsibility to obtain approved shop drawings signed by the Consultant and/or Owner per the General Conditions prior to fabrication.

C. Manufacturer's Reference:
1. Prime Manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

Pierce Steel Fabricators, Inc.

430 North 7th Street

Olean, NY 14760

Phone: (716) 372-7652

Website: https://www.piercesteel.com/

Work Bench Model: made to order 96"x48"x36" 2 ton

Alemite LLC

5148 N. Hanley Rd.

St. Louis, MO 63134

Phone: (800) 822-4579

Website: https://www.skf.com/alemite

Oil Barrel Lubrication Trolley Model: 343509

Grease Barrel Lubrication Trolley Model: 343510

Global Industries.

11 Harbor Park Dr.

Port Washington, NY 11050

Phone: (888) 978-7759

Website: https://www.globalindustries.com/

Industrial Mobile Computer Cart Model: T9F239115CBK

D. Other manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers may be considered as equal.

PART 2 PRODUCTS

2.01 SHOP EQUIPMENT GENERAL

A. The Contractor shall provide the following:
1. List of Required Items
a. New Shop Equipment as shown on the drawings, including freight, unloading, installation, touch-up painting, cleaning, and other equipment necessary to complete the system.

B. Quantity and Capacity
1. See drawings for equipment location and configuration.

C. Standard Designs

1. Components shall be of standard design and fabrication by the manufacturer so that all may be replaced or purchased at a future date without special charges or extended deliveries.

D. The Bill of Materials for this Work is to be determined by the Contractor from the bid drawings and contents of the Specifications. Shop Equipment Contractor to verify all information.

E. Codes
1. The Shop Equipment shall be designed and installed to the exact standards of the manufacturer and in all cases shall conform to applicable codes.

F. Loads and Capacity
1. The Shop Equipment shall be designed to handle specified loads.

G. Install
1. The shipment of the Shop Equipment shall include all components to allow immediate install upon receipt.

H. Anchoring
1. All work must be rigid and anchored securely. Method of attachment to be approved prior to installation.

I. Touch Up
1. The Shop Equipment Contractor shall touch up any other Contractor's work damaged during the process per section 3.02 Field Painting.

2.02 SHOP EQUIPMENT

A. General: Equipment Tag # MB-14 Work Bench (Qty. 4)
- a. Description: Heavy Duty Work Bench typically used in commercial Vehicle Maintenance and Repair Shops.
  - 1) Physical Data:
    - (a) Overall Dimensions:
      - (1) Width: 48”
      - (2) Depth: 96”
      - (3) Height: 36”
  - 2) Material: STEEL
- 2. Features and Construction:
  - a. 2 ton
  - b. Lower shelf
  - c. 2-year Manufacturer's warranty
- 3. Finish: Manufacture Standard Safety Yellow (unpainted table top)

B. General: Equipment Tag # MB-15 Industrial Mobile Computer Cart (Qty. 4)
- a. Description: Industrial Mobile Computer Cart typically used in commercial Vehicle Maintenance and Repair Shops.
  - 1) Physical Data:
    - (1) Overall Dimensions:
    - (2) Width: 48.5”
    - (3) Depth: 22.5”
    - (4) Height: 62.75”
  - 2) Max. Monitor Size: 24” Diagonal
  - 3) Material: STEEL
- b. Features and Construction:
  - 1) LCD Top Computer Cabinet yes
  - 2) Lower Locking Cabinet yes
  - 3) Side Shelves: 2
  - 4) Ventilation Fans: 2 w/ filters
  - 5) Sliding Mouse Tray yes
  - 6) 6-outlet Surge Protector yes
- c. Color: Dark Grey

C. 1-year Manufacturer's warranty

D. Finish: Manufacture Standard

PART 3 EXECUTION

3.01 EXAMINATION

A. Coordination

1. Each Contractor must give careful consideration to the ongoing facility operations and the work of other contractors during the entire project and shall organize his/her work so that it will not interfere with ongoing operations or interfere with or delay the work of others. Minimal disruption to ongoing operations is a priority. It is imperative that the schedule be maintained with any changes coordinated promptly with the General Contractor, Owner, and Consultant.

B. General Description

1. The Work Bench shall be installed true and properly aligned complete in all details and in accordance with the specifications, manufacturer's recommendations, and the drawings.

C. Installation Routine

1. Installation shall include unloading, checking and security of equipment prior to erection, shimming, complete anchoring, touch up and cleaning. The Contractor shall provide storage facilities (i.e., covers, closed containers) to protect equipment from the elements (i.e., dust, dirt, rain, snow, etc.). Contractor shall use a transfer system to bring materials inside the building that is supplied by the Contractor. Contractor to ensure no damage to the overhead door, floor, facility or equipment.

D. Tools and Equipment

1. The Contractor shall be responsible to provide all tools and equipment necessary for a complete and satisfactory installation. All wheeled and rolling equipment used in the building during construction (after slab on grade has been poured) must use wheel wraps as drip diapers or similar to protect floor from rubber marking and equipment spillage of oil or other substances.

E. Construction, lifts, man Lifts and Vehicles

1. All wheeled and rolling equipment used in the building during construction (after slab on grade has been poured) must use wheel wraps as drip diapers or similar to protect floor from rubber marking and equipment spillage of oil or other substances.

F. Permits and Inspection

1. Contractor shall obtain, and pay for, all necessary permit fees and inspections required by the State or local municipalities.

G. Damaged Materials

1. Claims, due to freight damage, are the responsibility of Work Bench Contractor. This includes any damage that is not evident at the time of the unloading of the equipment (i.e., concealed damage). Should such damage be uncovered, the Contractor must act promptly to repair/replace damaged equipment to minimize any delay to the schedule. Any added cost due to a delay is the responsibility of the Contractor.

H. Debris Disposal

1. It shall be the responsibility of the Work Bench Contractor to remove any debris resulting from his/her work on each and every workday to a pre-designated disposal area. This shall include all waste generated by the installer or any of his/her personnel, shipping containers, and/or construction materials. The Contractor shall broom clean the area each work day to leave the work area clean and allow the Owner access to scrub the floor. This will include organizing the materials not yet incorporated in the Work. At the completion of the work the Contractor shall remove all of his/her waste materials and rubbish from and about the project, as well as all his/her tools, construction equipment, machinery.

I. Clearance

1. The Contractor shall be responsible for maintaining all clearances specified on the drawings.

J. Modifications
   1. The Contractor shall be responsible for the suitability of any Work Bench component modifications required after installation begins. All modifications must be submitted and approved by the Owner and Consultant prior to beginning Work. Modifications done by others must be approved by the Contractor prior to modification. The Contractor shall be responsible for such a modification by others.

K. Contractor's Survey of Damage
   1. The Contractor shall conduct a survey of his/her work each and every workday morning and note any and all damages observed. Any damages must be reported to the General Contractor and the Owner by 9:00 a.m. Damages not reported within this time frame will be the contractor's responsibility.

L. Marking Restrictions
   1. Under no circumstances will a magic marker, sharpie or any other permanent marking device, which will absorb into concrete, paint or decking, be used for marking equipment locations. All markings must be water soluble and removable. The contractor is responsible to remove these markings prior to completing the Punch List

M. Installation
   1. The Owner shall have the option of performing his/her own Work Bench installation.

3.02 FIELD PAINTING

A. Cleaning
   1. All surfaces to be painted must be thoroughly cleansed of rust, scale, oil, grease, dirt, welding flash and all other forms of dirt detrimental to good painting practices.

B. Touch-Ups
   1. After the installations are complete, the Contractor shall touch-up any components that were damaged but only with owners/representative approval. Finish to match factory finish.

END OF SECTION 11 50 00

SECTION 11 53 00
EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish and install scales in the Home Hazardous Waste Facility Building.

1.02 REFERENCE STANDARDS

A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.

B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2022b.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2023.

E. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface 2022.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.

G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.

H. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide equipment dimensions and construction; equipment capacities; physical dimensions; utility and service requirements, clearances, and locations; required accessories and optional features; point loads.

C. Shop Drawings: Indicate equipment locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, installation and servicing clearances required.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Test Reports: Factory tests for each type of equipment.

F. Manufacturer's Installation Instructions: Indicate special installation requirements.

G. Operation Data: Include description of equipment operation and required adjusting and testing .

H. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources.

1.05 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the types of products specified in this section, with minimum seven years of documented experience.

B. Preconstruction Testing: Factory-test each type of equipment.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package each piece of equipment to ensure protection from damage during shipment and delivery. Legibly indicate on the exterior of each container or crate, the shipping address and a brief description of its contents. Outside of the container, fasten a waterproof envelope containing a packing list and complete instructions for uncrating and setting the equipment in place.

B. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.07 WARRANTY

A. Correct defective Work within a two year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Scales:
   1. Basis of Design Manufacturer and Product: Arlyn Series 5200, Large Floor Scales, All Electronic; Model #5-4405 Steel with USB connectivity.
   2. Manufacturers:
      a. Mettler-Toledo: https://www.mt.com/#sle.
      b. Rice Lake Weighing Systems: https://www.ricelake.com/#sle
      c. Arlyn Scales: https://www.arlynscales.com/#sle.
      d. Substitutions: See Section 1-06.7.

2.02 REGULATORY REQUIREMENTS

A. Comply with applicable codes for equipment.

B. Comply with UL requirements for fabrication and installation of equipment.

2.03 EQUIPMENT

A. Each item energized by a single switch.

B. Prewire and prepipe each unit of equipment complete with trim and fittings. Include reduced pressure or atmospheric type backflow preventer fitting to prevent backflow of polluted water or waste into water supply system or equipment. Comply with applicable code requirements.

C. Installation Accessories: Provide all rough-in frames, anchors, supports, accessories and closure trim required for complete installation.

D. Use corrosion-resistant materials for all rivets, bolts, nuts, studs, spacers, and welding metal.

E. Fully assemble equipment in factory, except for those items which cannot be moved to their final locations as single item due to shipping size restrictions.

2.04 SCALES

A. Type SC-1: Floor Scale.
   1. Size: 4 feet by 4 feet.
   2. Capacity: 5000 lb.
   3. Scale Profile: Very Low Profile Platform with large diamond plate platform only 2.8″ high, for ease of loading and unloading.
   4. Accuracy: Internal resolution up to 1:500,000 with nominal resolution at 1:5000.
   5. Load Center: Stainless steel load cell system for durability.
   6. Coatings: 3-part zinc rich galvanized epoxy coating system.
   7. Display: Remote mount water resistant display.
   8. Calibration: No set up or dealer services required with automatic calibration.
   9. Legs: Adjustable leveling legs.
   10. Operation: Pushbutton functions for tare and unit conversion.
   11. Overload Condition: Display warning message at 102% of scale capacity.
   12. Display Speed: 0.5 seconds, adjustable.
   13. Options: USB connectivity.

2.05 MATERIALS

A. Aluminum Sheet: ASTM B209/B209M, 5005-H32 minimum; alloy and temper recommended by aluminum producer and finisher for use and finish indicated.
   1. Finish: AAMA 2603

B. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) coating.

C. Steel Sheet: ASTM A1008/A1008M uncoated, cold rolled, Type CS (commercial steel), exposed or ASTM A879/A879M electrolytic zinc coating over ASTM A1008/A1008M steel sheet substrate.

D. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304 and 316, stretcher-leveled standard of flatness.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Fasteners: Stainless-steel, or other corrosion-resistant materials, standard with the manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that utility connections, rough-in frames, anchors and supports are accurately placed and deliver building services at specified characteristics and/or within acceptable functional ranges.

B. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Provide rough-in frame and anchors for placement.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with standards required by authority having jurisdiction.

C. Large Components: Ensure that large components can be moved into final position without damage to other construction.

D. Mounting: Anchor equipment securely in place.

E. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner, and their locations are coordinated with equipment rough-in requirements.

F. Touch-up minor damaged surfaces caused during installation. Replace damaged components as directed by Contracting Agency.

3.04 FIELD QUALITY CONTROL

A. Perform functional testing in accordance with referenced specification requirements. Test one item or similar model, as necessary or appropriate, to ensure that it is operational and installation complies with specification requirements.

3.05 ADJUSTING

A. Adjust operating equipment to efficient operation.

3.06 CLOSEOUT ACTIVITIES

A. Final Acceptance: Remove labels, fingerprints, and clean all surfaces both inside and out. Repair any marred or damaged surfaces that affect appearance, such as both interior and exterior of cabinets in a manner acceptable to Contracting Agency. Replace any parts that cannot be repaired in such a manner.

END OF SECTION 11 53 00

This page intentionally left blank

SECTION 11 53 13
LABORATORY FUME HOODS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Standard laboratory fume hoods.

B. Fume hood base cabinets and stands.

C. Work surfaces.

1.02 RELATED REQUIREMENTS

A. Section 09 21 16 - Gypsum Board Assemblies: Reinforcements in metal-framed partitions for anchoring fume hoods.

1.03 REFERENCE STANDARDS

A. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods 2016, with Errata.

B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2022b.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2023.

D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.

E. SEFA 1 - Laboratory Fume Hoods 2010.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate installation of fume hoods with laboratory casework and other laboratory equipment.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide fume hood exterior and interior dimensions and construction, utility and service requirements and locations, and other laboratory equipment.

C. Shop Drawings: Indicate locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, clearances required, locations and types of service fittings, and other laboratory equipment.

D. Samples: Submit two samples of exterior, interior, and work top finish surfaces, minimum 2" by 2" inch (51 by 51 mm) in size illustrating color and finish.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. Provide documentation of successful Factory Acceptance Testing.

F. Test Reports: Indicate that each type of fume hood has been factory-tested and meets specified ASHRAE Std 110 (AM) requirements.

G. Manufacturer's Installation Instructions: Indicate special installation requirements.

H. Operation Data: Include description of equipment operation and required adjusting and testing.

I. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources.

J. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Contracting Agency's name and registered with manufacturer.

K. Project Record Documents: Record actual locations of concealed utility connections.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.

C. Preconstruction Testing: Factory-test each type of hood as per referenced standard.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.08 FIELD CONDITIONS

A. Ambient Conditions: Maintain temperature and relative humidity at occupancy levels during and after installation of fume hoods.

1.09 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide one year manufacturer warranty for manufacturer's standard items (listed by part number in manufacturer's official publication).

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Laboratory Fume Hoods:
   1. Labconco Corporation: www.labconco.com/#sle.
   2. Kewaunee Scientific Corp: www.kewaunee.com/#sle.
   3. Mott Manufacturing Ltd: www.mott.ca/#sle.
   4. Multilab: www.multilab.net/#sle.

B. Provide laboratory fume hoods from same manufacturer as laboratory casework.

2.02 CONSTANT AIR VOLUME (CAV) FUME HOODS

A. Bypass Fume Hoods:
   1. Include a built-in compensating bypass arrangement to maintain constant exhaust volume regardless of sash position.

B. Auxiliary Air System:
   1. Include an-air outlet for connection to an external supply air source equal to 70 percent of the exhausted air volume. Introduce air directly above and immediately in front of hood face.

2.03 PERFORMANCE REQUIREMENTS

A. Fume hoods complying with the following when tested in accordance with ASHRAE Std 110:
   1. As-Manufactured (AM) Rating: AM 0.01 (0.01 ppm).
   2. As-Installed (AI) Rating: AI 0.10 (0.10 ppm).
   3. Average Face Velocity: 100 FPM (0.51 m/s) plus or minus 10 percent with sashes fully open.
   4. Face-Velocity Variation: Not more than 10 percent of average face velocity across the face opening with sash(es) fully open.
   5. Release Rate: 4.0 L/min.
   6. Static-Pressure Loss: Not more than 1/2-inch w.g. (124 Pa) at 100 FPM (0.51 m/s) face velocity with sash fully open when measured at four locations 90 degrees apart around the exhaust duct and at least three duct diameters downstream from duct collar.

2.04 FUME HOODS

A. General Requirements:
   1. Comply with SEFA 1.

B. Fume Hood:
   1. Basis of Design Product and Manufacturer: Labconco Corporation, 5' Protector XStream Laboratory Hood with 2 service fixtures and 1 electrical duplex, Catalog #110510002. (Distributor: H2I, 22121 17th Ave SE, Bothell, WA 98021, Brad Johnson)
   2. Ventilation: Constant Air Volume (CAV).
   3. Configuration: ADA-compliant.
   4. Nominal Interior Height: Minimum 59" inches (1499 mm).
   5. Sash Type: Vertical rising.
      a. Leak-free enclosure box, manufacturer's standard construction, for vertical rising sash.
      b. Glazing: Tempered safety glass.
      c. Sash Guides: Corrosion-resistant manufacturer's standard track.
      d. Vertical Sash mechanism: Designed to prevent sash drop in case of mechanism failure.
         1) Cable: Minimum 3/32 inch (2 mm) thick stainless steel of construction standard with the manufacturer.
      e. Vertical Sash Pull: Powder-coated.
   6. Exterior: Sheet steel.
   7. Interior Lining: 3/16" thick glass fiber reinforced polyester.
      a. Color/Finish: White.
   8. Access Panels: Provide removable panels on both sides hood exterior and interior lining panels.

C. Remote Base Cabinets:
   1. Basis of Design Product and Manufacturer: Labconco Corporation, 30” ADA Compliant Acid Cabinet, Catalog #9905400.
   2. Exterior construction: Metal with epoxy coating.
      a. Acid storage cabinets.
      b. Fire/solvent storage cabinets.
   3. Material: Sheet steel.
   4. Color/Finish: Matching fume hood finish.
   5. Size: 22" depth, 30" width.
   6. Height: ADA Compliant 31.5" (83.2 cm) minimum to 32.75 (80.0 cm) maximum.
   7. Accessory Filler Panels: Provide two 8” enclosure panels for base cabinets to close space from base cabinets to wall.
      a. Basis of Design Product and Manufacturer: Labconco Corporation, 8" Filler Panels, Catalog #9920306.

D. Fume Hood Base Stand:
   1. Basis of Design Product and Manufacturer: Labconco Corporation, 30” Electric Hydraulic Lift, Catalog #3780306.
   2. Construction: Welded steel tubing legs, not less than 1 1/2 inch (38 mm) square.
      a. Color/Finish: Matching fume hood finish.
   3. Vertical Adjustment Mechanism: Electric hydraulic lift. Work surface height range from 25.5 inch (572 mm) to 33.5 inch (851 mm) or higher.
   4. Leg Levelers: Manufacturer's standard.
   5. Leg Shoes: Manufacturer's standard.
   6. Structural Performance: Capable of withstanding 50 pounds per foot (74 kg/m) work top, 75 pounds per foot (112 kg/m) on work top, plus weight of hood, without permanent deformation or excessive deflection.
   7. Structural Performance of Fume Hood Base Stands for Radioisotope Hoods: Capable of withstanding 50 pounds per foot (74 kg/m) work top, 200 pounds per foot (297 kg/m) on work top, plus weight of hood, without permanent deformation or excessive deflection.
   8. Knee Space: Clear floor space not less than 36 inches (915 mm) wide by 25 inches (635 mm) front-to-back by 27 inches (685 mm) high, unless otherwise indicated.
   9. Height: ADA Compliant.

E. Fume Hood Work Surface:

1. Basis of Design Product and Manufacturer: Labconco Corporation, 5' SpillStopper Solid Epoxy Fume Hood Work Surface, Catalog #9503500.
2. Construction and Properties:
   a. Material: 1.25" thick, molded from special formulation of corrosion-resistant epoxy resins with spill stopper work surface
   b. Front Edge: Large radius to aerodynamically direct airflow into the fume hood.
   c. Configuration: Surface dished and contoured to conform to the interior liner of hood.
   d. Mechanical:
   e. Depth: 30 inches.
   f. Width: 60 inches.
   g. Height: ADA Compliant.
   h. Flexural Strength: Not less than 10,000 psi (70 MPa).
   i. Modulus of Elasticity: Not less than 2,000,000 psi (1400 MPa).
   j. Hardness (Rockwell M): Not less than 100.
   k. Water Absorption (24 Hours): Not more than 0.02 percent.
   l. Heat Distortion Point: Not less than 260 deg F (127 deg C).
   m. Flame-Spread Index: 25 or less per ASTM E 84.

F. Remote Base Cabinets Work Surface:
1. Basis of Design Product and Manufacturer: Labconco Corporation, 5' Solid Epoxy Work Surface, Catalog #4882807.
2. Construction and Properties:
   a. Material: 1.25" thick, molded from solid modified epoxy resin, with smooth, non-specular dark finish.
   b. Front Edge: 1 inch radius.
   c. Depth: 30 inches.
   d. Width: 50 inches.
   e. Height: ADA Compliant.
   f. Flexural Strength: Not less than 10,000 psi (70 MPa).
   g. Modulus of Elasticity: Not less than 2,000,000 psi (1400 MPa).
   h. Hardness (Rockwell M): Not less than 100.
   i. Water Absorption (24 Hours): Not more than 0.02 percent.
   j. Heat Distortion Point: Not less than 260 deg F (127 deg C).
   k. Flame-Spread Index: 25 or less per ASTM E 84.

G. Light Fixtures: UL labeled, vaporproof, one-tube, T-5 fluorescent light fixtures. Number and length of fixtures as necessary for fume hood width. Mounted above sealed safety glass panel. White baked-enamel finish on fixture interior.

2.05 FABRICATION

A. General: Assemble fume hoods in factory to greatest extent possible. Disassemble fume hoods only as necessary for shipping and handling limitations, or as necessary to permit movement through a 35 inches by 79 inches (889 mm by 2007 mm) clear door opening.

B. Ends: Fabricated with double-wall end panels. Close area between double walls at front of fume hood and as needed to house sash counterbalance weights, utility lines, and remote-control valves.

C. Lining Assembly: Unless otherwise indicated, assembled with stainless-steel fasteners or epoxy adhesive, concealed where possible. Joints sealed by filling with chemical-resistant sealant during assembly.
1. Punched fume hood lining side panels for service fittings and remote controls. Removable plug buttons for holes not used for indicated fittings.

D. Rear Baffle: Same material as fume hood lining, unless otherwise indicated, at rear of hood with openings at top and bottom, with corrosion-resistant fasteners. Fabricated for removal to facilitate cleaning behind baffle.

E. Exhaust Plenum: Full width of fume hood, sized and configured to provide uniform airflow, of same material as hood lining, and with duct stub for exhaust connection.
1. Duct-Stub Material: Epoxy-coated steel, unless otherwise indicated.

F. Airfoil: At bottom of fume hood face opening, with 1 inch (25.4 mm) gap between bottom of airfoil and work top. Sash to close on top of airfoil. Designed to direct airflow across work.
   1. Fabricated from 14 gauge, 0.0781 inch (1.98 mm) stainless steel with No.4 finish.

G. Comply with requirements of other sections for factory installation of water and laboratory gas service fittings, piping, electrical devices, and wiring. Securely anchor fittings, piping, and conduit to fume hoods, unless otherwise indicated.

2.06 MATERIALS

A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A1008/A1008M; matte finish; suitable for exposed applications.

B. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Fasteners: Stainless-steel, where exposed to fumes.

2.07 ACCESSORIES

A. Airflow Monitors/Indicators and Alarms: Provide each fume hood with a airflow monitor/indicator complete with an audible and visual alarm that activates when airflow sensor reading is outside of preset range.
   1. Source: Fume hood manufacturer.
   2. Airflow Monitor/Indicator Functionality:
   3. Airflow Alarm functionality: Audible (85 dB @ 4 inch (102 mm) distance), and visual alarm that activates when airflow sensor reading is outside of preset range.
      a. Reset and test mode.
      b. Programmable Switch: Designed to silence audible alarm and automatically reset when airflow returns to within preset range. Warning light to stay on when alarm is silenced.
      c. Capability for integration with BAS (Building Automation System) via BACnet.

2.08 SOURCE QUALITY CONTROL

A. Factory testing of each type of fume hood.

B. Remove and replace all non-performing or deflective items so final installing is complete and operational per manufacturers specifications and requirements.

END OF SECTION 11 53 13

This page intentionally left blank

SECTION 12 24 00
WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior manual roller shades.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.03 REFERENCE STANDARDS

A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).

B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films 2023, with Errata.

C. WCMA A100.1 - Standard for Safety of Window Covering Products 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
   2. Do not install shades until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.

D. Selection Samples: Include fabric samples in full range of available colors and patterns.

E. Verification Samples: Minimum size 6 inches (150 mm) square, representing actual materials, color and pattern.

F. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Contracting Agency's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum 5 years of documented experience with shading systems of similar size and type.

1.07 MOCK-UP

A. Mock-Up: Provide full size mock-up of window shade system complete with selected shade fabric including example of seams when applicable.
   1. Obtain Contracting Agency's approval of light and privacy characteristics of fabric prior to fabrication.
   2. Full-sized mock-up may become part of the final installation.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.09 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
   1. Shade Hardware: 10 years.
   2. Fabric: 10 years.
   3. Aluminum and Steel Coatings: 10 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interior Manually Operated Roller Shades:
   1. Draper, Inc; Clutch Operated FlexShade: www.draperinc.com/#sle.
   2. Hunter Douglas Architectural; RB500 Manual Roller Shades: www.hunterdouglas.com/#sle.
   3. Lutron Electronics Co., Inc; Contract Roller Manual Roller Shades: www.lutron.com/#sle.
   4. MechoShade Systems LLC; Mecho/7 System: www.mechoshade.com/#sle.
   5. Substitutions: See Section 1-06.7.

B. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 ROLLER SHADES

A. General:
   1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
   2. Provide shade system that operates smoothly when shades are raised or lowered.

B. Roller Shades Type #1:
   1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
      a. Drop Position: Regular roll.
      b. Roll Direction: Roll down, closed position is at window sill.
      c. Fabric: Hunter Douglas; Greenscreen Seatex 3%
   2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
      a. Material: Stamped steel.
   3. Roller Tubes: As required for type of shade operation.
      a. Material: Extruded aluminum, clear anodized finish.
      b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
      c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
      d. Take-Up Roller: Manufacturer's standard roller tube pretensioned for winding lift cable in bottom-up type shades.
   4. Hembars: Designed to maintain bottom of shade straight and flat.
      a. Style: Exposed aluminum bottom bar, oval profile with closed ends; clear anodized finish.
   5. Manual Operation for Interior Shades:

a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
b. Drive Chain: Continuous loop beaded ball chain, 95 lb (43 kg) minimum breaking strength. Provide upper and lower limit stops.
c. Shade Lift Assistance: Manufacturer's standard spring device contained in the idler end of roller tube to reduce force required to lift shades; as required based on shade weight.
d. Chain Retainer:
1) Chain tensioning device complying with WCMA A100.1.
2) Manufacturer's standard clip.

6. Accessories:
a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; clear anodized finish.
1) Profile: Square.
b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.
c. Fasteners: Noncorrosive, and as recommended by shade manufacturer.

2.03 SHADE FABRIC

A. Fabric for Room-Darkening Shades: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
1. Manufacturers:
a. Lutron Electronics Co., Inc: www.lutron.com/#sle.
b. MechoShade Systems LLC: www.mechoshade.com/#sle.
c. Hunter Douglas: www.hunterdouglas.com/#sle.
d. Substitutions: See Section 1-06.7.
2. Basis of Design Material: Hunter Douglas; Sunbrella Solar Collection.
3. Material Certificates and Product Disclosures:
a. Cradle to Cradle Material Health Certificate: Achievement level of Bronze.
4. Performance Requirements:
a. Flammability: Pass NFPA 701 large and small tests.
b. Fungal Resistance: No growth when tested according to ASTM G21.
5. Basis of Design Openness Factor: 3% Solistico.
6. Basis of Design Color: Slate.

2.04 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: As recommended in writing by manufacturer.

C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. If substrate preparation is the responsibility of another installer, notify Contracting Agency of unsatisfactory preparation before proceeding.

C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Replace shades that exceed specified dimensional tolerances at no extra cost to Contracting Agency.

C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.05 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation and maintenance of window shade system to Contracting Agency's personnel.

B. Training: Train Contracting Agency's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide training by manufacturer's authorized personnel at location designated by the Contracting Agency.

3.06 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION 12 24 00

SECTION 12 32 00
MANUFACTURED WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured standard casework, with cabinet hardware.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.

B. Section 09 21 16 - Gypsum Board Assemblies: Reinforcements in metal-framed partitions for anchoring casework.

C. Section 09 65 00 - Resilient Flooring: Resilient wall base.

D. Section 12 36 00 - Countertops: Additional requirements for countertops.

1.03 DEFINITIONS

A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches (1.066 m) above finished floor, tops of cases less than 72 inches (1.82 m) above finished floor and all members visible in open cases or behind glass doors.

B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches (1.828 m) above finished floor and bottoms of cabinets more than 30 inches (0.762 m) but less than 42 inches (1.066 m) above finished floor.

C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than 30 inches (762 mm) above finished floor.

1.04 REFERENCE STANDARDS

A. ANSI A135.4 - Basic Hardboard 2012 (Reaffirmed 2020).

B. AWI (QCP) - Quality Certification Program Current Edition.

C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).

D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards 2021, with Errata.

E. BHMA A156.9 - Cabinet Hardware 2020.

F. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood 2020.

G. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.06 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Component dimensions, configurations, construction details, joint details, attachments.

C. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements, placement dimensions and tolerances, clearances required, and keying information.

D. Samples for Finish Selection: Fully finished, for color selection. Minimum sample size: 2 inches by 3 inches (51 mm by 75 mm).
   1. Plastic laminate samples, for color, texture, and finish selection.

E. Manufacturer's Installation Instructions.

F. Installer's Qualification Statement.

G. Maintenance Data: Manufacturer's recommendations for care and cleaning.

H. Maintenance Materials: Furnish the following for Contracting Agency's use in maintenance of project:
   1. See Section 1-06.9 for additional maintenance provisions.
   2. Tools: One each of every special tool required for maintenance of cabinets.

I. Finish touch-up kit for each type and color of materials provided.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

B. Quality Certification: Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
   1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   2. Provide designated labels on shop drawings as required by certification program.
   3. Provide designated labels on installed products as required by certification program.
   4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
   5. Replace, repair, or rework all work for which certification is refused.

C. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.

B. Acceptance at Site:
   1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.

C. Storage:
   1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification of Conditions" Article of this section.

1.09 MOCK-UPS

A. Provide full size base cabinet complete with drawers, door, adjustable shelf and countertop.

B. See Section 1-06.8 for additional mock-up requirements.

C. Mock-up may remain as part of the work.

1.10 WARRANTY

A. See Sections 1-05.10 and 1-06.5 for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion, at no additional cost to Contracting Agency. Defects include, but are not limited to:
   1. Ruptured, cracked, or stained finish coating.
   2. Discoloration or lack of finish integrity.
   3. Cracking or peeling of finish.
   4. Delamination of components.
   5. Failure of adhesives.
   6. Failure of hardware.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Plastic Laminate Casework:
   1. Case Systems: www.casesystems.com/#sle.
   2. Diversified Fixture: www.diversifiedfixture.com/#sle.
   3. Labscape LLC: www.labscape.com/#sle.
   4. Substitutions: See Section 1-06.7.

B. Obtain casework from single source and manufacturer, unless otherwise indicated.

2.02 CASEWORK, GENERAL

A. Quality Standard: AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Faced Cabinets: Custom Grade.

2.03 FABRICATION

A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.

B. Construction: As required for selected grade.

C. Structural Performance: Safely support the following minimum loads:
   1. Base Units: 500 pounds per linear foot (744 kgs/linear m) across the cabinet ends.
   2. Suspended Units: 300 pounds (136 kg) static load.
   3. Drawers: 125 pounds (57 kg), minimum.
   4. Hanging Wall Cases: 300 pounds (135 kg).
   5. Shelves: 100 pounds (45 kg), minimum.

D. Seismic Performance: Casework, including attachments to other work, able to withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. Component Importance Factor: 1.0.

E. Hardware Application: Factory-machine casework members for hardware that is not surface applied.

F. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

G. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.

2.04 PLASTIC-LAMINATE-CLAD CASEWORK

A. Plastic-Laminate-Clad Casework: Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.
   1. Style: Flush overlay. Ease doors and drawer fronts slightly at edges.
   2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
      a. Base Cabinets: 24 inches (610 mm).
      b. Tall Cabinets: 13 inches (330 mm).
      c. Wall Cabinets: 13 inches (330 mm).
   3. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
      a. Finish: Matte or suede, gloss rating of 5 to 20.
      b. Surface Color and Pattern: As noted below..
         1) Base Cabinets: Wilsonart HD Laminate Ruskin Oak 17002K - 57; Aligned Texture.
         2) Upper Cabinets: Wilsonart Grey Ash; 4877-38
      c. Exposed Interior Surfaces: Thermally fused laminate.
         1) Color: White.
      d. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.

e. Cap exposed plastic laminate finish edges with material of same finish and pattern.

2.05 CABINET HARDWARE

A. Comply with BHMA A156.9 requirements.
   1. Acceptable base materials for plated finishes include brass, bronze, and steel.

B. Locks: Provide locks on casework drawers and doors where indicated. Lock with 5 pin cylinder and 2 keys per lock.
   1. Hinged Doors: Cam type lock, bright chromium plated over nickel on base material.
   2. Keying: Key locks alike within a space; key each room separately.
   3. Master Key System: All locks operable by master key.

C. Shelves in Cabinets:
   1. Shelf Standards and Rests: Vertical standards with rubber button fitted rests, satin chromium plated over nickel on base material.

D. Swinging Doors: Hinges, pulls, and catches.
   1. Hinges: Concealed, number as required by referenced standards for width, height, and weight of door.
      a. Concealed Hinges: Installed in cabinet edge, and on door back, bright chromium plated over nickel on base material.
         1) European-Style Hinges for Overlay Doors: 110 degree opening angle.
   2. Pulls: Chrome wire pulls, 4 inches (102 mm) wide.
      a. Pull design to comply with project's referenced accessibility requirements.
   3. Catches: Magnetic.

E. Drawers: Pulls and slides.
   1. Pulls: Chrome wire pulls, 4 inches (102 mm) wide.
      a. Pull design to comply with project's referenced accessibility requirements.
   2. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.

2.06 MATERIALS

A. Wood-Based Materials:
   1. Solid Wood: Air-dried to 4.5 percent moisture content, then tempered to 6 percent moisture content before use.
   2. Composite Wood Panels: Containing no urea-formaldehyde resin binders.

B. Solid Wood: Clear, dry, sound, plain sawn, selected for compatible species, grain and color, no defects.

C. Semi-Exposed Solid Wood: Dry, sound, plain sawn, no appearance defects, any species similar in color and grain to exposed portions.

D. Hardwood Plywood: Veneer core; HPVA HP-1 Grade as indicated; same species as exposed solid wood, clear, compatible grain and color, no defects. Band exposed edges with solid wood of same species as veneer.

E. Concealed Solid Wood or Plywood: Any species and without defects affecting strength or utility.

F. Hardboard: ANSI A135.4, Class 1, tempered.

G. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications. complying with Grade requirements, and standard with the manufacturer.

H. Thermally Fused Laminate (TFL): Melamine resin, NEMA LD 3, Type VGL laminate panels.

2.07 ACCESSORIES

A. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

B. Concealed Joint Fasteners: Corrosion-resistant, standard with manufacturer.

C. Grommets: Standard plastic grommets for cut-outs, in color to match adjacent surface.

D. Sealant for Use in Casework Installation:
   1. Manufacturer's recommended type.

PART 3 EXECUTION

3.01 PREPARATION

A. Large Components: Ensure that large components can be moved into final position without damage to other construction.

3.02 EXAMINATION

A. Site Verification of Environmental Conditions:
   1. Do not deliver casework until the following conditions have been met:
      a. Building has been enclosed (windows and doors sealed and weather-tight).
      b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
      c. Ceiling, overhead ductwork, piping, and lighting have been installed.
      d. Installation areas do not require further “wet work” construction.

B. For Base Cabinets Installation: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 1/2 inch (13 mm) leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.

C. For Wall Cabinets Installation: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
   1. Maximum variation from plane of masonry wall exceeds 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more, and/or maximum variation from plumb exceeds 1/4 inch (6 mm)per story.
   2. Maximum Variation of finished gypsum board surface from true flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

D. Verify adequacy of support framing and anchors.

E. Verify that service connections are correctly located and of proper characteristics.

3.03 INSTALLATION

A. Perform installation in accordance with manufacturer's instructions.

B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.

C. Set casework items plumb and square, securely anchored to building structure.

D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.

E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch (1.6 mm). In addition, do not exceed the following tolerances:
   1. Variation of Tops of Base Cabinets from Level: 1/16 inch (1.6 mm) in 10 feet (3 m).
   2. Variation of Bottoms of Wall Cabinets from Level: 1/8 inch (3 mm) in 10 feet (3 m).
   3. Variation of Faces of Cabinets from a True Plane: 1/8 inch (3 mm) in 10 feet (3 m).
   4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch (0.8 mm).
   5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch (1.6 mm).

F. Secure wall and floor cabinets to concealed reinforcement at gypsum board assemblies.

G. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches (407 mm) on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.

H. Wall Cabinets: Fasten to hanging strips, and/or wall substrates. Fasten each cabinet through back, near top, at not less than 16 inches (407 mm) on center.

I. Install hardware uniformly and precisely.

J. Countertops: Install countertops intended and furnished for field installation in one true plane, with ends abutting at hairline joints, and no raised edges.

K. Replace units that are damaged, including those that have damaged finishes.

3.04 ADJUSTING

A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

3.05 CLEANING

A. Clean casework and other installed surfaces thoroughly.

3.06 PROTECTION

A. Do not permit finished casework to be exposed to continued construction activity.

B. Protect casework and countertops from ongoing construction activities. Prevent workmen from standing on, or storing tools and materials on casework or countertops.

C. Repair damage, including to finishes, that occurs prior to Date of Substantial Completion, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION 12 32 00

SECTION 12 36 00
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for manufactured casework.

B. Wall-hung counters and vanity tops.

1.02 RELATED REQUIREMENTS

A. Section 123200 - Manufactured Wood Casework.

B. Section 22 40 00 - Plumbing Fixtures: Sinks.

1.03 REFERENCE STANDARDS

A. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire 2019.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.

C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).

D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards 2021, with Errata.

E. IAPMO Z124 - Plastic Plumbing Fixtures 2022.

F. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material 2013.

G. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

H. NSI (DSDM) - Dimensional Stone Design Manual, Version VIII 2016.

I. PS 1 - Structural Plywood 2019.

1.04 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.

D. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

F. Installer's qualification statement.

G. Installation Instructions: Manufacturer's installation instructions and recommendations.

H. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
   1. Flat Sheet Thickness: 1-1/4 inch (32 mm), minimum.
   2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard stone fabrication tools; no surface coating; color and pattern consistent throughout thickness.
   3. Basis of Design Manufacturer and Product: Wilsonart quartz agglomerate; Lorraine Q1012.
      a. Manufacturers:
         1) Cambria Company LLC: www.cambriausa.com/#sle.
         2) Dal-Tile Corporation: www.daltile.com/#sle.
         3) Wilsonart: www.wilsonart.com/#sle.
         4) Cosentino: www.cosentino.com.
         5) Substitutions: See Section 1-06.7.
      b. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with NSI (DSDM).
      c. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      d. NSF approved for food contact.
      e. Finish on Exposed Surfaces: Polished.
   4. Other Components Thickness: 3/4 inch (19 mm), minimum.
   5. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
   6. Fabricate in accordance with manufacturer's standard requirements.

2.02 MATERIALS

A. Wood-Based Components:
   1. Wood fabricated from old growth timber is not permitted.

B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.

C. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

D. Joint Sealant: Mildew-resistant silicone sealant, clear.

2.03 ACCESSORIES

A. Fixed Top-Mounted Countertop Support Brackets:
   1. Material: Steel.
   2. Finish: Manufacturer's standard, factory-applied, textured powder coat.
   3. Color: Black.
   4. Products:
      a. Centerline Brackets; Front Mounting Countertop Support: www.countertopbracket.com/#sle.
      b. Substitutions: See Section 1-06.7.

2.04 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
      a. Rout a 1/8 inch (3 mm) drip groove at underside of exposed overlapping edges, set back 1/2 inch (13 mm) from face of edge.
   3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches (102 mm), unless otherwise indicated.

C. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Contracting Agency of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install vanities in accordance with manufacturer’s instructions and approved shop drawings

B. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

C. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.

B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.

C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.05 CLEANING

A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 12 36 00

This page intentionally left blank

SECTION 12 48 13
ENTRANCE FLOOR MATS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Extruded aluminum entrance floor grilles.

B. Recessed mat frames.

1.02 SUBMITTALS

A. See Section 1-06 for additional submittal requirements.

B. Product Data: Provide data indicating properties of walk-off surface, component dimensions and recessed frame characteristics.

C. Shop Drawings: Indicate dimensions and details for recessed frame.

D. Samples: Submit two samples, 6 by 6 inch (152.4 by 152.4 mm) in size illustrating pattern, color, finish, and edging.

E. Maintenance Data: Include cleaning instructions, and stain removal procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Entrance Floor Grilles and Mat Basis of Design, The Mad Matter; I-Beam Aluminum Foot Grille 1 3/4": Mat color charcoal.

B. Entrance Floor Grilles and Mat:
   1. Activar Construction Products Group - JL Industries; Activ-Grate™ 900 Series - Rigid Entrance Grate: www.activarcpg.com/#sle.
   2. Babcock-Davis; Rigid Entrance Grate GRATEdesign: www.babcockdavis.com/#sle.
   3. Nystrom, Inc; Rigid Entrance Grate GRATEdesign: www.nystrom.com/#sle.
   4. Reese Enterprises, Inc; PERFEC™ GRATE: www.reeseusa.com/#sle.
   5. The Mad Matter; I-Beam Aluminum Foot Grille: https://madmatter.com/#sle.
   6. Substitutions: See Section 1-06.7.

2.02 ENTRANCE FLOOR GRILLES AND GRATINGS

A. Entrance Floor Grilles: Recessed extruded aluminum grille assembly with nominal 1 inch (25 mm) wide tread strips running perpendicular to traffic flow, slots between treads, and perimeter frame forming sides of recess; grille hinged for access to recess.
   1. Recess Depth: 1-1/2 inches (38 mm) minimum,.
   2. Tread Surfaces: Nylon carpet.
   3. Colors: Charcoal.
   4. Length in Direction of Traffic Flow: See Drawings.
   5. Width Perpendicular to Traffic Flow: See Drawings.
   6. Frame: Anodized aluminum for embedding in concrete; minimal exposed trim; stud or hook concrete anchors.

B. Mounting: Top of non-resilient members level with adjacent floor.

C. Structural Capacity: Capable of supporting a rolling load of 400 pounds (181.4 kg) without permanent deformation or noticeable deflection.

D. Vibration Resistant Fabrication: All members welded, riveted, or bolted; no snap or friction connections.

2.03 FABRICATION

A. Construct recessed mat frames square, tight joints at corners, rigid. Coat surfaces with protective coating where in contact with cementitious materials.

B. Fabricate mats in single unit sizes; fabricate multiple mats where indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor opening for mats are ready to receive work.

3.02 PREPARATION

A. Mats: Verify size of floor recess before fabricating mats.

B. Vacuum clean floor recess.

3.03 INSTALLATION

A. Install frames to achieve flush plane with finished floor surface.

B. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.

3.04 TOLERANCES

A. Maximum Gap Formed at Recessed Frame From Mat Size: 1/4 inch (6 mm).

END OF SECTION 12 48 13

SECTION 14 45 13
VEHICLE LIFT EQUIPMENT

PART 1 GENERAL

1.01 FURNISHED BY CONTRACTOR INSTALLED BY CONTRACTOR (FCIC)

A. Vehicle Lift Equipment shall be Furnished by Contractor, Installed by Contractor (FCIC)

1.02 SYSTEM DESCRIPTION

A. Equipment item is listed below by Equipment I.D. Tag.
   1. Four Post Vehicle Lift with four post Bridge Jack.
      a. Equipment I.D. Tag: MB-08 (Qty. 1)

B. Vehicle Lift Equipment
   1. This section includes the specifications for Vehicle Lift Equipment that are being installed for the lifting of vehicles of various sizes and weights, as noted in the Bid Specifications and Bid Drawing Package.
   2. Vehicle Lift Equipment – Description of System(s)
      a. The configurations for Vehicle Lift are described below.
         1) Standalone equipment for the lifting of vehicles for service on an assortment of Cars and Light / Heavy Duty Trucks.

C. Seismic Calculations
   1. For seismic calculations, Reference general seismic design criteria noted on Sheet S0.1 Division 1 – General, A.9.

D. List of Applicable Forms
   1. The General Conditions, Supplementary Conditions, Instructions to Bidders, Bid Form, all apply to these bid items.

1.03 DESCRIPTION OF WORK

A. List of Work
   1. The extent of the Work is shown on the drawings and is defined to include (but not by way of limitations) all labor, materials, freight, unloading, equipment, taxes, permits and supervision required for equipment and installation.

B. Coordination
   1. Contractor’s Responsibility: It will be the Contractor's responsibility to verify and establish a detailed installation schedule.
   2. Field Check: ALL BUILDING AND EQUIPMENT LAYOUT DIMENSIONS SHALL BE FIELD CHECKED AND VERIFIED BY CONTRACTOR PRIOR TO START OF INSTALLATION. NOTIFY THE CONSULTANT AND OWNER OF ANY DISCREPANCIES OR CONDITIONS AFFECTING MATERIALS AND/OR INSTALLATION WITHIN TEN (10) DAYS. IF A CONDITION EXISTS AND THE CONSULTANT OR OWNER IS NOT NOTIFIED THE ADDITIONAL COST TO CORRECT THE INSTALLATION IN ACCORDANCE WITH THE REQUIREMENTS OF THE OWNER WILL BE THAT OF THE CONTRACTOR.
   3. Delivery and Unloading: The Vehicle Lift Contractor shall be responsible for coordinating the delivery and unloading of the equipment to the job-site with the General Contractor to eliminate demurrage charges, unless authorized by the Owner or the Consultant. In order to eliminate disruption to the ongoing operations and prevent interference of dock access by trucks entering and leaving the site, temporary staging of materials will be provided outside of the building at a location designated by the Owner. The Vehicle Lift Contractor shall provide storage facilities (i.e. covers, closed containers) to protect equipment from the elements (i.e. dust, dirt, rain, ice, snow, etc.) as necessary. Interior staging of equipment will be kept to a minimum so as not to disrupt ongoing operations.

1.04 QUALITY ASSURANCE

A. Standards

1. Equipment Standards: The equipment covered by these Specifications shall be designed, assembled, tested and installed in accordance with the latest applicable standards, including:
    a. American National Standards Institute (ANSI).
    b. American Iron and Steel Institute.
        1) Specification for Design of Cold-Formed Steel Association - "Structural Members" 2015 edition.
    c. International Building Code (IBC)
        1) International Building Code including current Building Code Amendments. (2015 Edition)
    d. Seismic Zone
        1) The seismic zone for the project is Seismic Zone 3 with near source distance factors applied.
    e. Materials
        1) All materials furnished shall be new, free from defects, and UL-Approved where such approval is granted to the equipment to be furnished.
    f. Federal Inspection
        1) Latest published applicable Federal Specifications.
    g. OSHA
        1) Applicable OSHA Specifications.
    h. Building and Safety Codes
        1) Any applicable local building and safety codes pertaining to the Work.

B. Workmanship
    1. Trade Methods: Use the best trade methods throughout. Work evidencing substandard workmanship shall be corrected or replaced by the Contractor at the Contractor's expense, per the General Conditions.

C. Touch Up Paint: The method for the touch up of paint shall follow specifications section 3.02 Field Painting.

D. Guarantees
    1. WARRANTY:
        a. Warranty shall be the manufacturer's standard warranty and shall be specified by the Contractor in the contents of the proposal.
        b. The contractor shall provide an extended warranty for a period of three (3) years from Date of Acceptance.
    2. QUALITY OF MATERIALS AND EQUIPMENT: The Contractor guarantees the material and equipment delivered under the Contract to be free from defects in design or workmanship and against damages caused prior to final inspection. Unless otherwise specified, this guarantee extends for a period of three (3) years from the Date of Acceptance for both labor and materials.
    3. REPAIRING DEFECTS: The Contractor shall promptly repair or replace all defective or damaged items delivered under the Contract. The Vehicle Lift Contractor may elect to have any replaced item returned to his/her plant at his/her expense.

1.05 SUBMITTALS

A. Product Data: Submit latest edition of Vehicle Lift data sheet and outline drawing with the proposal.
    1. Shop Drawings:
        a. Shop Drawings, as stated in the General Conditions, shall include, but need not be limited to:
        b. Installation Plan: Proposed installation plan of equipment, including location and dimensions of new equipment clearly identified. It will be the Contractor's responsibility to verify and establish a detailed installation schedule per the General Conditions.
        c. Dimensions: Plan views showing all equipment dimensions along with any aisle clearance dimensions.

d. Bill of Materials: Bill of Materials per the General Conditions.
e. Approved Shop Drawings
f. It will be the Contractor's responsibility to obtain approved shop drawings signed by the Consultant and/or Owner per the General Conditions prior to fabrication.

B. Manufacturer's Reference:
1. Prime Manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

Stertil-Koni

200 Log Canoe Circle

Stevens, Maryland 21666

Phone: (800) 336-6637

Website: https://www.stertil-koni.com/

Vehicle Lift Model: ST-1085-2FWA (set of four)

BendPak

1645 Lemonwood Dr.

Santa Paula, CA 93060

Phone: (800) 993-9970

Website: https://www.bendpak.com/

Four Post Vehicle Lift Model: HDS-14(X)

Four Post Bridge Jack: RJ9W

C. Other manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers may be considered as equal.

PART 2 PRODUCTS

2.01 VEHICLE LIFT EQUIPMENT GENERAL

A. The Contractor shall provide the following:
1. List of Required Items
a. New Vehicle Lift as shown on the drawings, including freight, unloading, installation, touch-up painting, cleaning, and other equipment necessary to complete the system.

B. Quantity and Capacity
1. See drawings for equipment location and configuration.

C. Standard Designs
1. Components shall be of standard design and fabrication by the manufacturer so that all may be replaced or purchased at a future date without special charges or extended deliveries.
2. The Bill of Materials for this Work is to be determined by the Contractor from the bid drawings and contents of the Specifications. Vehicle Lift Contractor to verify all information.

D. Codes
1. The Vehicle Lift shall be designed and installed to the exact standards of the manufacturer and in all cases shall conform to applicable codes.

E. Loads and Capacity
1. The Vehicle Lift shall be designed to handle specified loads.

F. Install
1. The shipment of the Vehicle Lift shall include all components to allow immediate install upon receipt.

G. Anchoring

1. All work must be rigid and anchored securely, use 1/2" through bolts and lock nuts. Method of attachment to be approved prior to installation.

H. Anchor Holes
1. All anchor holes are to be vacuum cleaned at time of drilling.

I. Touch Up
1. The Vehicle Lift Contractor shall touch up any other Contractor's work damaged during the process per section 3.02 Field Painting.

2.02 VEHICLE LIFT

A. General: Equipment Tag # MB-08 Vehicle Lift (Qty. 1)
1. Description: 14,000 lbs. lifting capacity Heavy Duty Vehicle Lift typically used in commercial Vehicle Maintenance and Repair Shops.
a. Physical Data:
1) Overall Dimensions:

(a)	Width:	130”
(b)	Length:	243”
(c)	Overall Length:	271”
(d)	Height of Column:	92”
(e)	Min. Runway Height:	7.75”
(f)	Max. Lifting Height:	7’- 4”
(g)	Width between columns:	120”
(h)	Runway Width:	20”
(i)	Width between runways:	37.5” to 51.5”
(j)	Length of Runways:	236”
(k)	Power Requirements:	220V, 50/60 Hz 1ph

b. Features and Construction:
1) 15 Locking positions
2) Lock spacing every 4”
3) 2-year Manufacturer’s warranty
c. Finish: Manufactures Standard

B. General: Equipment Tag # MB-08 4-Post Bridge Jack (Qty. 1)

C. Description: 9,000 lbs. lifting capacity four post bridge jacks made by the same manufacture and compatible with the proposed four post lift.

a.	Min. Drive-Over Height:	
b.	Pad Only Height:	8”
c.	Pad + Max. Adapters Height:	10.75”
d.	Max. Lifting Height:	
e.	Pad Only Height:	16.25”
f.	Pad + Max. Adapters Height:	21.75”
g.	Reach:	
h.	Support Base:	45” to 50”
i.	Max. Arm reach:	56”
j.	Min. Arm Reach:	42”
k.	Air Requirements:	125 psi (10-20 cfm)

2. Features and Construction:
a. 2-year Manufacturer’s warranty
3. Finish: Manufactures Standard (Black and Yellow)

PART 3 EXECUTION

3.01 EXAMINATION

A. Coordination
1. Each Contractor must give careful consideration to the ongoing facility operations and the work of other contractors during the entire project and shall organize his/her work so that it will not interfere with ongoing operations or interfere with or delay the work of others.

Minimal disruption to ongoing operations is a priority. It is imperative that the schedule be maintained with any changes coordinated promptly with the General Contractor, Owner, and Consultant.

B. General Description
   1. The Vehicle Lift shall be installed true and properly aligned complete in all details and in accordance with the specifications, manufacturer's recommendations, and the drawings.

C. Installation Routine
   1. Installation shall include unloading, checking and security of equipment prior to erection, shimming, complete anchoring, touch up and cleaning. The Contractor shall provide storage facilities (i.e. covers, closed containers) to protect equipment from the elements (i.e. dust, dirt, rain, snow, etc.). Contractor shall use a transfer system to bring materials inside the building that is supplied by the Contractor. Contractor to ensure no damage to the overhead door, floor, facility or equipment.

D. Tools and Equipment
   1. The Contractor shall be responsible to provide all tools and equipment necessary for a complete and satisfactory installation. All wheeled and rolling equipment used in the building during construction (after slab on grade has been poured) must use wheel wraps as drip diapers or similar to protect floor from rubber marking and equipment spillage of oil or other substances.

E. Construction, lifts, man Lifts and Vehicles
   1. All wheeled and rolling equipment used in the building during construction (after slab on grade has been poured) must use wheel wraps as drip diapers or similar to protect floor from rubber marking and equipment spillage of oil or other substances.

F. Permits and Inspection
   1. Contractor shall obtain, and pay for, all necessary permit fees and inspections required by the State or local municipalities.

G. Damaged Materials
   1. Claims, due to freight damage, are the responsibility of Vehicle Lift Contractor. This includes any damage that is not evident at the time of the unloading of the equipment (i.e. concealed damage). Should such damage be uncovered, the Contractor must act promptly to repair/replace damaged equipment to minimize any delay to the schedule. Any added cost due to a delay is the responsibility of the Contractor.

H. Debris Disposal
   1. It shall be the responsibility of the Vehicle Lift Contractor to remove any debris resulting from his/her work on each and every workday to a pre-designated disposal area. This shall include all waste generated by the installer or any of his/her personnel, shipping containers, and/or construction materials. The Contractor shall broom clean the area each work day to leave the work area clean and allow the Owner access to scrub the floor. This will include organizing the materials not yet incorporated in the Work. At the completion of the work the Contractor shall remove all of his/her waste materials and rubbish from and about the project, as well as all his/her tools, construction equipment, machinery.

I. Clearance
   1. The Contractor shall be responsible for maintaining all clearances specified on the drawings.

J. Modifications
   1. The Contractor shall be responsible for the suitability of any Vehicle Lift component modifications required after installation begins. All modifications must be submitted and approved by the Owner and Consultant prior to beginning Work. Modifications done by others must be approved by the Contractor prior to modification. The Contractor shall be responsible for such a modification by others.

K. Contractor’s Survey of Damage
   1. The Contractor shall conduct a survey of his/her work each and every workday morning and note any and all damages observed. Any damages must be reported to the General

Contractor and the Owner by 9:00 a.m. Damages not reported within this time frame will be the contractor's responsibility.

L. Marking Restrictions
   1. Under no circumstances will a magic marker, sharpie or any other permanent marking device, which will absorb into concrete, paint or decking, be used for marking equipment locations. All markings must be water soluble and removable. The contractor is responsible to remove these markings prior to completing the Punch List

3.02 FIELD PAINTING

A. Cleaning
   1. All surfaces to be painted must be thoroughly cleansed of rust, scale, oil, grease, dirt, welding flash and all other forms of dirt detrimental to good painting practices.

B. Touch-Ups
   1. After the installations are complete, the Contractor shall touch-up any components that were damaged but only with owners/representative approval. Finish to match factory finish.

END OF SECTION 14 45 13

SECTION 21 05 00

COMMON WORK RESULTS FOR FIRE SUPPRESSION SYSTEMS

1.01 GENERAL REQUIREMENTS

A. Conditions: Conform to all Bidding Requirements, General Conditions and Amendments to General Conditions, Supplementary and Special Conditions, and General Requirements, WSDOT Division 01, which govern Work herein specified. Comply with above in addition to requirements of this section. Modifications by this section do not nullify other portions of above-referenced conditions.

1.02 SCOPE

A. Work Included: Provide labor, materials, and appliances, and perform operations in connection with installation of Work in strict accordance with these Specifications and Drawings. Intent of these documents is to require provision of complete, functional, and operational systems that comply with performance requirements specified.

B. Work Requirements: Design and provide a complete fire sprinkler system including pipe, fittings, valves, flow switches, valve tamper and low air pressure switches, gauges, compressor, drain pipe, test connections, and sprinklers. Include accessories to meet required codes, standards, and requirements of authorities having jurisdiction. Fire sprinkler system shall be an all-new system.

C. Additional Work Requirements: Design shall ensure that electrical equipment in elevator machine rooms, hoistways, and personal lift machines is de-energized prior to application of sprinkler water. Design shall accomplish this in a manner satisfactory to both elevator inspector and authorities having jurisdiction. Coordinate with requirements of Divisions 14 and 28.

D. Contractor's Responsibility: Drawings are diagrammatic in part and do not attempt to show complete details of installation. Provide a complete, operable system. Provide additional valves, piping, sprinklers, offsets in piping, accessories, etc., as may be required by authorities having jurisdiction, at no additional cost to Contracting Agency. In addition to above requirements, provide sprinkler protection in air handling plenums to extent required by authorities having jurisdiction, including, but not limited to, filter banks.

1.03 DEFINITIONS

A. General: In addition to definitions and abbreviations provided for in Division 21, refer to Division 01 for additional terminology used in this Project Manual Specification.

B. Provide: Where referenced in Division 21, "provide" shall mean furnish and install, complete and ready for the intended use.

C. Access:
   1. Accessible: When applied to a fixture, connection, appliance, or equipment, "accessible" shall mean having access thereto, but which first may require removal of an access panel, door, or obstruction.
   2. Readily Accessible: Shall mean direct access without necessity of removing an access panel, door, or obstruction.

D. Contractor: Division 21 is written in imperative mode. Use of word "shall" creates a Contractor obligation, regardless of whether or not word "Contractor" is used.

E. Mechanical Engineer: Where referenced in Division 21, "Mechanical Engineer" shall mean Architect's Consulting Mechanical Engineer, P2S Inc.

F. Product Manufacturers:
   1. General: In "Part 2, Product sections" of this Specification, products are specified followed by one or more named manufacturers. Where a "model number" or "type" designation is also provided (either on Drawings or in this Specification), intent is this shall form basis of design.
   2. Other Named Product Manufacturers: Where multiple manufacturers have been named for a particular product, if one of these manufacturers is selected to provide a specified

product, manufacturer shall meet or exceed quality and performance requirements of model or type specified forming basis of design.

3. Other Manufacturers: Where Contractor proposes to submit a product from a manufacturer other than those listed in this specification, follow either prior approval or substitution requirements specified elsewhere.

G. Contracting Agency's Representative: See Division 01.

H. Reviewed: Where referenced in Division 21, "Reviewed" shall mean "Reviewed by Project's Consulting Mechanical Engineer, P2S Inc."

I. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

J. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

K. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

L. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

M. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

N. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.04 APPLICABLE CODES AND STANDARDS

A. Latest Edition: Unless otherwise noted by publication date, various documents referenced herein shall be latest standard, specification, manual, code, law, or regulation in effect and adopted by governing authority at time of opening of bids (or on effective date of Agreement if there are no bids).

B. Requirements: Comply with requirements of following codes:
1. International Building Code (IBC), including Seattle Amendments.
2. International Fire Code (IFC), including Seattle Amendments.
3. International Mechanical Code (IMC), including Seattle Amendments.
4. IBC Section 903 "Automatic Sprinkler Systems."
5. NFPA 13, "Standard for Installation of Sprinkler Systems."
6. NFPA, Automatic Sprinkler System Handbook.
7. NFPA 70, "National Electric Code."
8. NFPA 72, "National Fire Alarm."
9. NFPA 230, "Standard for the Fire Protection of Storage."
10. Washington Revised Code RCW 70.41.080: Fire Protection."
11. Local Elevator Inspector.
12. Underwriters Laboratories (UL) Fire Protection Equipment Directory with Quarterly Supplements.
13. Factory Mutual Approval Guide.

C. Additional Requirements: In addition, comply with codes and standards required by authorities having jurisdiction.

D. Latest Published Edition of NFPA: Where governing authority has not adopted latest published edition of NFPA at time of bid, design and provide to requirements of latest published edition of NFPA at time of bid unless otherwise directed by governing authority.

1.05 DRAWINGS AND SPECIFICATIONS

A. Drawings and Specifications: Drawings and Specifications form one document. If conflicts occur between Drawings and Specification, most stringent or most costly requirement shall govern and shall be used for bidding purposes. Bring conflicts to immediate attention of Contracting Agency for clarification.

1.06 DIVISION OF TRADES

A. Responsibility: Various sections of Division 21 herein are not intended to indicate a division of work or responsibility between trades involved in this Work. Read and conform to this Specification and provide specified materials, labor, services, etc. See Division 01 for additional requirements.

1.07 ABBREVIATIONS LIST

A

A	Compressed Air
AAV	Automatic Air Vent
ACD	Automatic Control Damper
ACV	Automatic Control Valve
AD	Area Drain
AF	Air Foil
AFF	Above Finished Floor
AL	Aluminum
ALT	Alternate
AMU	Air Measuring Unit
APD	Air Pressure Drop
APPROX	Approximate(ly)
ARCH	Architect or Architectural
AUX	Auxiliary
AV	Acid Vent
AVG	Average
AW	Acid Waste

B

BDD	Backdraft Damper
BF	Blind Flange
BFW	Boiler Feedwater
BHP	Brake Horsepower
BLDG	Building
BOD	Bottom of Duct Elevation AFF
BSMT	Basement
BTUH	British Thermal Units per Hour
BTWN	Between
BV	Ball Valve
BWG	Bottom Wall Grille
BWR	Bottom Wall Register

C

C	Centigrade
CA	Control Air
CB	Catch Basin
CD	Ceiling Diffuser
CFH	Cubic Feet per Hour
CFM	Cubic Feet per Minute
CFS	Cubic Feet per Second
CG	Ceiling Grille
CHR	Chilled Water Return
CHS	Chilled Water Supply
CI	Cast Iron
CIRC	Circulation
CKV	Check Valve
CLG	Ceiling
CMU	Concrete Masonry Unit
CO	Cleanout
COL	Column
CONC	Concrete
CONN	Connection or Connect
CONST	Construction or Construct
CONT	Continuous or Continuously or Continued
COORD	Coordinate
COP	Coefficient of Performance
CORR	Corridor
CO2	Carbon Dioxide
C0202	95% Oxygen, 5% Carbon Dioxide Mix
CR	Ceiling Register or Condensate Return
CTR	Center
CU FT	Cubic Feet
CW	Cold Water
CWR	Condenser Water Return
CWS	Condenser Water Supply

D

D	Deep, Depth, or Drain
dB	Decibel
DB	Dry Bulb
DCVA	Double Check Valve Assembly
DCW	Drinking Chilled Water
DCWR	Drinking Chilled Water Recirculation
□	Degrees
DET	Detail or Detergent
DI	Deionized Water
DIA or	Diameter
DIAG	Diagram
DIM	Dimension
DIR	Deionized Water Recirculation
DL	Drip Leg
DLT	Double Light Troffer
DN	Down
DPG	Differential Pressure Gage, Gauge
DS	Downspout
DSP	Dry Standpipe
DV	Dry Vacuum Cleaning Line
DW	Distilled Water
DWDI	Double Width Double Inlet
DWG	Drawing
DWR	Distilled Water Recirculation
DWV	Drain, Waste, Vent

E

E	East or Exhaust
EA	Each
EAT	Entering Air Temperature
EER	Energy Efficiency Ratio
EFF	Efficient or Efficiency
ELEC	Electric
ELEV	Elevation (Grade)
EP	Electric/Pneumatic
EQ	Equivalent
EQJ	Earthquake Joint
EQUIP	Equipment
ESP	External Static Pressure
ET	Exhaust Temperature
ETO	Ethylene Oxide
EWT	Entering Water Temperature
EXH	Exhaust
EXIST	Existing

F

F	Fahrenheit or Fire Sprinkler Line
FA	Face Area
F&SD	Combination Fire and Smoke Damper
F&T	Float and Thermostatic Trap
FC	Forward Curve
FCO	Floor Cleanout
FD	Fire Damper or Floor Drain
FDC	Fire Department Connection
FF	Finish Floor
FG	Finish Grade or Floor Grille
FH	Fire Hydrant
FHC	Fire Hose Cabinet
FIC	Furnished and Installed by Contractor
FIO	Furnished and Installed by Contracting Agency
FLEX	Flexible
FLR	Floor
FM	Factory Mutual
FO	Fuel Oil
FOIC	Furnished By Contracting Agency, Installed By Contractor
FOR	Fuel Oil Return
FOS	Fuel Oil Supply
FOT	Fuel Oil Tank
FOV	Fuel Oil Vent
FPI	Fins per Inch
FPM	Feet per Minute
FPS	Feet per Second
FR	Floor Register
FT	Foot or Feet
FTG	Footing or Fitting
FV	Face Velocity

G

G	Natural Gas
GA	Gage, Gauge
GAL	Gallon
GALV	Galvanized
GCO	Grade Cleanout
GLR	Glycol Return
GLS	Glycol Supply
GLV	Globe Valve
GOVT	Government
GPH	Gallons per Hour
GPM	Gallons per Minute
GPS	Gallons per Second
GR	Grille
GT	Grease Trap
GV	Gate Valve
GWB	Gypsum Wallboard
GYP	Gypsum

H

H	High, Height
HB	Hose Bibb
HCR	High-pressure Condensate Return
HD	Head
HEDV	Hose End Drain Valve
Hg	Mercury
HP	Horsepower
HPS	High-pressure Steam
HR	Hour or Heat Pump Return
HS	Heat Pump Supply or Humidity Sensor
HTG	Heating
HTR	Heater
HW	Hot Water
HWC	Hot Water Recirculation
HWR	Hot Water Return
HWS	Hot Water Supply

I

ID	Inside Diameter
IE	Invert Elevation
IN	Inch
INSUL	Insulate or Insulation
ISOL	Isolate or Isolation

J

JST	Joist

K

K	Thermal Conductivity BTU in/(hour ft2 F°)
KW	Kilowatt

L

L	Long or Length
LA	Laboratory Compressed Air
LAT	Leaving Air Temperature
LAV	Lavatory
LB	Linear Boot
LB or #	Pound
LBS or #	Pounds
LCR	Low Pressure Condensate Return
LCW	Lab Cold Water
LD	Linear Diffuser
LF	Lineal Foot/Feet
LHW	Lab Hot Water
LHWC	Lab Hot Water Recirculation
LPS	Low Pressure Steam
LV	Lab Vacuum
LWT	Leaving Water Temperature

M

MA	Medical Compressed Air
MAT	Mixed Air Temperature
MAV	Manual Air Vent
MAX	Maximum
MBH	1,000 British Thermal Units per Hour
MECH	Mechanical
MEZZ	Mezzanine
MFR	Manufacture or Manufacturer
MH	Manhole
MIN	Minimum
MISC	Miscellaneous
MV	Medical Vacuum

N

N	North
NC	Normally Closed
NIC	Not in Contract
NO	Normally Open
NO or #	Number
NP	Non-Potable Cold Water
NPSH	Net Positive Suction Head
NPT	National Pipe Thread
NTS	Not to Scale
N2	Nitrogen
N2O	Nitrous Oxide

O

OAT	Outside Air Temperature
OC	On Center
OD	Outside Diameter
OPNG	Opening
OPP	Opposite
ORD	Overflow Roof Drain
ORIG	Original
ORL	Overflow Rainleader
OSA	Outside Air
OS & Y	Outside Screw and Yoke
OV	Outlet Velocity
OZ	Ounce
O2	Oxygen

P

PAF	Preaction Fire Line
PAR	Parallel
PCF	Pounds per Cubic Foot
PCR	Pumped Condensate Return
PCW	Pressurized Cold Water
PE	Pneumatic/Electric
PERF	Perforated
PERP	Perpendicular
PG	Pressure Gage, Gauge
PH	Phase
PHW	Pressurized Hot Water
PIV	Post Indicator Valve
PL	Plate
PLBG	Plumbing
PLWD	Plywood
PNEU	Pneumatic
POC	Point of Connection
PP	Polypropylene
PREFAB	Prefabricated
PRELIM	Preliminary
PRV	Pressure Reducing Valve
PSF	Pounds per Square Foot
PSI	Pounds per Square Inch
PSIG	Pounds per Square Inch Gage, Gauge
PT	Pint
PVC	Polyvinyl Chloride

R

R	Return
R	Replenisher (Film Processor)
RCP	Reflected Ceiling Plan or Reinforced Concrete Pipe
RD	Roof Drain
RECIRC	Recirculation
RECT	Rectangular
RELOC	Relocate or Relocated
REQD	Required
RET	Return
RL	Rainleader
RM	Room
RO	Reverse Osmosis
ROR	Reverse Osmosis Return
ROS	Reverse Osmosis Supply
RPBP	Reduced Pressure Backflow Preventer
RPM	Revolutions per Minute
RV	Relief Valve
RVD	Remote Volume Damper
RW	Right(s)-of-Way

S

S	Supply or South or Soil
SA	Shock Arrestor or Supply Air
SAN	Sanitary
SAT	Supply Air Temperature
SCHED	Schedule
SCHEM	Schematic
SD	Slot Diffuser or Smoke Damper
SECT	Section
SHT	Sheet
SIM	Similar
SLT	Single Length Troffer Diffuser
SM	Sheet Metal
SP	Static Pressure
SPEC	Specification
SQ	Square
SQ FT	Square Feet
SR	Silver Recovery
SS	Sanitary Sewer
SST	Stainless Steel
ST	Storm Sewer
STD	Standard
STER	Sterilizer
STL	Steel
STM	Steam
STOR	Storage
STRUCT	Structural or Structure
SUP	Supply
SUSP	Suspend(ed)
SV	Safety Valve or Solenoid Valve
SVV	Safety Valve Vent
SW	Soft Water
SWP	Steam Working Pressure
SWSI	Single Width Single Inlet

T

T	Tempered Water
TDH	Total Dynamic Head
TE	Top Elevation
TEMP	Temperature
TH	Thermometer
THRU	Through
TOD	Top of Duct
TP	Total Pressure
TPV	Trap Primer Valve
TSP	Total Static Pressure or Temperature Sensor
TVE	Turning Vane Elbow
TWG	Top Wall Grille
TWR	Top Wall Register
TYP	Typical

U

UH	Unit Heater

V

V	Vent or Volts
VAC	Vacuum
VB	Vacuum Breaker or Valve Box
VD	Volume Damper
VENT	Ventilate or Ventilation
VERT	Vertical
VIB	Vibration
VOL	Volume
VP	Velocity Pressure
VTR	Vent through Roof
VV	Vacuum Vent

W

W	Waste or Watt or West
W/	With
WB	Wet Bulb
WC	Water Closet
WCO	Wall Cleanout
WG	Water Gauge
WH	Wall Hydrant
W/O	Without
WOG	Water, Oil, Gas Working Pressure
WPD	Water Pressure Drop
WSP	Wet Standpipe
WT	Weight
WV	Wet Vacuum Cleaning Line

Y

YD	Yard
YH	Yard Hydrant

1.08 AUTHORITIES HAVING JURISDICTION

A. Governing Authorities: Comply with requirements and recommendations of following authorities: Local Fire Department, State Fire Marshal.

1.09 PRE-BID COORDINATION

A. System Review: Review system requirements during bid period with authorities having jurisdiction, including special or unusual requirements, and provide for them in contract price. Provide electrical power requirements associated with fire protection equipment (air compressor, tamper switches, etc.).

1.10 COORDINATION OF ELECTRICAL WORK

A. Electrical: Provide electrical work in connection with mechanical installation as indicated on Drawings and specified herein. Conform to applicable paragraphs of electrical sections of this Project Specification and coordination requirements of Division 01.

1.11 MECHANICAL PAYMENT REQUEST

A. General: Application for Payment, Schedule of Values, for general requirements.

B. Format: Provide cost breakdown of mechanical work by building as follows:
   1. Mobilization and Permits
   2. Submittals and Shop Drawings
   3. Outside Utilities
   4. Fire Sprinklers, Rough-In
   5. Fire Sprinklers, Finish
   6. Testing, Adjusting, and Clean-Up
   7. Commissioning
   8. Record Drawings
   9. O & M Manuals
   10. Project Closeout

1.12 INSTALLED PRODUCTS

A. Contractor's Responsibility: Fixtures, equipment, and other installed materials shall perform and function in accordance with requirements of Contract Documents. Replace installed products that do not meet requirements.

1.13 FIXTURE OR EQUIPMENT ORDERS

A. Placing of Orders: Written and signed review from Contracting Agency is required prior to Contractor placing orders. Verbal permission is not considered final. Resubmit within 15 days fixture and equipment data found not satisfactory by Contracting Agency.

1.14 SUBSTITUTIONS

A. See Section 106.7, Product Options and Substitution Procedures.

B. Responsibility: Fixtures, equipment, and materials scheduled on Drawings are selected and configured to fit in mechanical spaces available, and to conform to available electrical, architectural, and structural characteristics. Prior to issuing submittals, ensure that substitute fixtures, equipment, or materials will fit without change in function or quality and without a redesign of spaces affected.

C. Coordination: Coordinate changes required due to substitute equipment with design disciplines and subcontractors. Pay for required modifications.

D. Conflicts: Should conflicts occur due to substitution of fixtures, equipment, or materials from those upon which mechanical design is based, Contractor is responsible for all costs incurred. Required redesign, as determined by Contracting Agency, shall be at Contractor's expense. Redesign or modifications to Contract Documents will be by P2S Inc, on a time-and-materials basis at current billing rates, and paid for by Contractor.

1.15 SUBMITTALS

A. General: See Section 1-06

B. Processed Submittals: Submittals processed by Contracting Agency are not change orders; purpose of submittals is to demonstrate to Contracting Agency that Contractor understands design concept, demonstrating understanding by indicating which equipment and material will be furnished and installed and by detailing fabrication and installation methods. Submittal review does not include review of accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes, construction means or methods, coordination of Work with other trades, or construction safety precautions, which are sole responsibility of Contractor. If deviations, discrepancies, or conflicts between submittals and Contract Documents in form of design Drawings and Specifications are discovered either prior to or after submittals are processed by Contracting Agency, Design Drawings and Specifications shall control and be followed.

C. Requirements:
   1. Within 60 days of Contract award, submit following:
      a. Shop Drawings.
         1) Requirements: Submit Shop Drawings for review prior to fabrication. Initial submittal shall have six copies submitted to Contracting Agency. Three copies shall be returned to Contractor, who shall make corrections if so noted. If no corrections are required by Contracting Agency, proceed to obtain approval of authorities having jurisdiction. Prior to installation, submit one set of Drawings (which has been stamped approved by authorities having jurisdiction to Contracting Agency.
         2) Corrections: If corrections are required by Contracting Agency or authorities having jurisdiction, another six copies shall be submitted to Contracting Agency.
         3) Drawings: In addition to requirements of Section 1-06, Shop Drawings shall include detail drawings of sprinkler systems, including sections and a plot plan showing location of underground supply connections, outside control valves, fire department connections, and other equipment to be used. Shop Drawings shall include electrical power requirements associated with sprinkler systems. Coordinate with other trades. Shop Drawings shall show sprinkler heads, piping, piping supports, valves, earthquake protection, hydraulic calculations, etc., as may be required to formally meet requirements of applicable codes, standards, and authorities having jurisdiction.
      b. Brochures (catalog data).
      c. Lists of materials giving manufacturer’s names, catalog numbers, trade names, cuts, and detailed descriptions.
      d. Hydraulic calculations.
      e. Seismic bracing calculations.
   2. Submit following materials and equipment:
      a. Items specified in Part 2 (Products) in each section of Division 21.
      b. Fire protection items listed on equipment schedules on Drawings.
   3. When more than one item of its kind appears on submittal data, designate a particular article selected by both type and size. Submittals with multiple technical paragraphs shall identify specific information in submittal that confirms compliance with Specification. Provide cross-reference to Specification paragraph numbers. Intent is to expedite review by Contracting Agency in verifying Contractor’s conformance with product specification requirements. Submittals that do not provide cross-reference shall be stamped “Rejected/Resubmit” and returned to Contractor.
   4. Submitted data sheets shall contain information and product characteristics scheduled and specified.
   5. Where scheduled or specified information is not included in manufacturer’s standard cut sheets, include a separate statement typed on manufacturer’s letterhead to assure that Contract Document intent is carried out.

6. Clearly indicate on each submittal specification reference (section and paragraph), an equipment item number from drawing schedules.
7. Turn in submittal data as a single unit in an indexed binder. Submittals not indexed and identified will be rejected without further review.
8. Do no fabrication, manufacture, or purchasing of products until receipt of Contracting Agency reviewed submittals.
9. Keep a complete set of stamped reviewed submittals at job site for duration of Project.

D. Resubmittal: Submittals that are returned “Rejected” require a complete resubmittal for entire product. Submittals returned “Note Markings” require written verification that comments by Contracting Agency have been acknowledged and product submittal will comply. Resubmittal shall delineate changes made from original submittal.

E. Additional Requirements:
1. See each section of Division 21 for layout and Shop Drawing requirements.
2. Mechanical equipment and devices, whose selection is in part dependent on flow or pressure drop, require a submittal that is specific for each point of use on job. Submit information for range or points specific to equipment or devices used on this job. Base submittal on manufacturer’s recommendations for design conditions intended (i.e., flow and pressure drop) and delineate specific size and selection criteria for each application. Include catalog cuts of charts, curves, etc. (computer generated curves are not acceptable). Where a piece of equipment is used in repeated applications, provide a matrix delineating required information (pressure drop, flow, etc.) and identify each point of use on job. Proper equipment selection, unless otherwise specifically required by Contract Documents, is further defined as being at or near midpoint of a particular piece of equipment’s operating range for static conditions (fixed operating points) or within manufacturer’s recommended operating range for dynamic conditions (variable operating range) when providing or operating at design conditions.

1.16 QUALITY ASSURANCE

A. Qualifications of Contractor:
1. All Work shall be performed by a contractor with a valid Washington State contractor’s license.
2. The system shall be designed by a NICET Level 3 certified sprinkler designer. The field installation shall be supervised at all times by a journeyman sprinkler fitter.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, “Structural Welding Code – Steel.”

C. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, “Welding and Brazing Qualifications.”
1. Comply with provisions in ASME B31 Series, “Code for Pressure Piping.”
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.17 DELIVERY, STORAGE, AND HANDLING

A. Pipes with Factory-Applied Caps: Deliver pipes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Sunlight: Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

C. Protection: Material and equipment that is intended to be installed and operated inside completed building envelope shall be protected. It is Contractor's responsibility to deliver all material and equipment to Contracting Agency at completion of Work in "as new condition." "As new condition" shall mean free of corrosion, dirt, rust, stain, or physical damage resulting from or during transportation to site, temporary storage at site, and construction period. Contractor must address potential damage to material and equipment caused by exposure to elements including wind, rain, and construction process. Contactor shall take all precautions to protect material and equipment. Precautions shall include, but not be limited to, protection from moisture to ensure material and equipment remain dry, and equipment is reasonably free of debris. Store products subject to damage by elements above ground, under cover in a weather-tight enclosure, with heat and ventilation adequate to prevent condensation. Material and equipment that have been exposed to moisture are subject to timely replacement by Contractor at no additional cost to Contracting Agency.

1.18 COORDINATION

A. The Contract Documents are diagrammatic in showing certain physical relationships that must be established within the mechanical Work and in its interface with other work, including utilities and electrical work, and that such establishment is the exclusive responsibility of the Contractor, unless noted otherwise. It shall be Contractor's responsibility to provide a complete, operable system. Any additional valves, piping, offsets in piping, accessories, etc., as may be required, shall be provided at no additional cost to Contracting Agency.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for fire-suppression installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. In addition to requirements of this Division, see Division 08, Section "Access Doors and Frames."

E. Coordination of Electrical Work: Provide electrical work in connection with mechanical installation as indicated on Drawings and specified herein. Conform to applicable paragraphs of electrical specifications, Division 26, and coordination requirements of Division 01.

F. System Review: Review system requirements during bid period with authorities having jurisdiction, including any special or unusual requirements, and provide for them in Contract price. Provide electrical power requirements associated with all fire protection equipment.

1.19 SUPPORT EQUIPMENT

A. Requirements: Provide scaffolding, ladders, and other appliances required for Work.

1.20 TEMPORARY UTILITIES

A. Facilities:
   1. Refer to Section 104.12, Temporary Utilities, for requirements for temporary water, heat, fire protection, and sanitary service.
   2. Use of permanent HVAC systems for temporary heat is not allowed.

1.21 EQUIPMENT START-UP

A. Manufacturers' Warranties: Do not violate manufacturers' warranties. Perform start-up in such a manner that warranties remain in full effect. Operation during construction and before acceptance requires permission of Contracting Agency.

B. Equipment Operation: Start up and operate equipment only when system conditions comply with safety rules and regulations, and system is clean and protected against airborne dust and dirt.

1.22 PERMITS

A. Permits: Paid for and obtained by Contractor. Submit copies of signed permits to Contracting Agency. See Division 01 and General Conditions A201 for additional requirements.

1.23 PROJECT RECORD DOCUMENTS

A. Refer to Division 1-05.5(2) for additional requirements.
   1. All changes, deviations and information recorded on the “Project Record Drawings” set during Construction shall be marked on the “Project Record Drawings,” in red ink.

1.24 OPERATIONS AND MAINTENANCE (O & M) MANUALS

A. O & M Manuals: Provide O & M Manuals in conformance with requirements of Section 1-06.5 Submit manuals for review by Contracting Agency at least 45 normal workdays prior to Contracting Agency’s operating and instruction period. Information shall be indexed by specification section, including the following:
   1. Manufacturers’, suppliers’, and subcontractors’ names, addresses, and phone numbers.
   2. Schedule and description of routine maintenance for each component including oiling, lubrication, and greasing data.
   3. Contractor’s Test and Materials Certificates per NFPA standards.
   4. Manufacturers’ cuts and rating tables, including brochures for equipment specified under required submittals. Information shall be complete and specific for actual products used on Project. Generic information covering a range of products, product types, or product ranges is not acceptable. Clean copies of plumbing fixtures, trim, valves, and piping specialties are acceptable.
   5. Part numbers of replaceable items.
   6. ASME data certification from manufacturer.
   7. Written guarantees.
   8. Copies of system tests done during system installation.
   9. See remaining sections in this specification for additional O & M Manual requirements.

1.25 OPERATING AND INSTRUCTION PERIOD FOR CONTRACTING AGENCY’S PERSONNEL

A. Demonstration: Refer to Section 1-06.5, Starting and Adjusting, Operations and Maintenance Data. Conduct demonstration for Contracting Agency’s operational personnel for one day after systems are fully operational, and when agreed to by Contracting Agency. Provide Notice of Readiness to conduct such instruction and demonstration to Contracting Agency.

B. Description: Following installation of mechanical equipment and prior to acceptance of mechanical work, conduct demonstrations and instruction periods to point out locations of servicing points and required points of maintenance to Contracting Agency.

C. Mechanical Contractor’s Representatives: Foremen or superintendents from trades involved.

D. Description of Instruction Periods: Include preliminary discussion and presentation of information from O & M Manuals with references to Contract Documents, followed by a tour of systems explaining maintenance requirements, access methods, servicing and maintenance procedures, equipment cleaning procedures, control settings, and available adjustments.

PART 2 PRODUCTS

2.01 GENERAL

A. Materials and Equipment: All materials and equipment in the system shall be new and current products of a manufacturer regularly engaged in the production of such materials and equipment. Where two or more pieces of equipment are required to perform interrelated functions, they shall be products of one manufacturer.

B. Approval Guides: Unless otherwise indicated, all products shall be listed in the latest publication of Approval Guides for Underwriters Laboratory and Factory Mutual for the service intended.

C. Acceptable Manufacturers: Manufacturer of sprinkler specialties shall be Grinnell, Reliable, or Viking, unless otherwise specified.

2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 piping sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 21 piping sections for special joining materials not listed below.

2.04 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5,000-psi, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

2.05 FIRE-STOPPING MATERIALS

A. General: Provide a UL listed fire-stop system per the requirements of Division 7.

2.06 IDENTIFICATION

A. General: See Section 21 05 53.

PART 3 EXECUTION

3.01 GENERAL

A. Requirements Prior to Installation: Do not order, fabricate, or install any material prior to receipt of all reviews as stipulated in Part 1 of this section.

B. Standards and Requirements: Perform all installation work in accordance with the reference standards without exception, and as required by the authorities having jurisdiction. Install all piping straight, true, and plumb.

C. Changes to the Work: Install all piping as shown on the reviewed Shop Drawings. Carefully note any minor deviations on the record drawings as outlined in Part 1 of this section. Before making significant deviations from the reviewed Drawings, obtain written approval from the Contracting Agency and the authorities having jurisdiction.

D. Coordination of Work: Carefully coordinate Work with other trades so that unnecessary offsets and revisions to the reviewed Drawings are avoided. Failure to coordinate does not relieve Contractor from meeting performance standards.

3.02 PENETRATIONS

A. Required Clearance Around Pipe: Provide piping that passes through fire rated assemblies, including fire-rated GWB assemblies, with clearance around the entire circumference of the pipe as required by NFPA 13. Penetrations of walls, floors, or ceilings shall be made in a neat manner using properly sized hole saw or masonry fire-stopping/concrete coring as necessary.

B. Fire-Rated Assemblies: The annular space between the wall or pipe sleeve and the sprinkler pipe in fire-rated assemblies shall be filled with UL classified material in accordance with the manufacturer's recommendation.

C. Escutcheons: Install split wall plates or escutcheons where exposed piping or hangers pass through a finished floor, wall, or ceiling, fitting these snugly and securely, and covering the opening.

3.03 PIPING SYSTEMS – COMMON REQUIREMENTS

A. General: Install piping according to the following requirements and Division 21 sections specifying piping systems.

B. Deviations: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Concealed Locations: Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Exposed Locations: Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Accessible Ceilings: Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Servicing: Install piping to permit valve servicing.

G. Sloped Piping: Install piping at indicated slopes.

H. Installation: Install piping free of sags and bends.

I. Fittings: Install fittings for changes in direction and branch connections.

J. Insulated Piping: Install piping to allow application of insulation.

K. Pressure Ratings: Select system components with pressure rating equal to or greater than system operating pressure.

L. Pipe Penetrations Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

M. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire-stop materials. Refer to Division 07, Section “Penetration Fire-stopping” for materials.

N. Rough In: Verify final equipment locations for roughing-in.

O. Other Requirements: Refer to equipment specifications in other sections of this specification for roughing-in requirements.

3.04 PIPING JOINT CONSTRUCTION

A. General: Join pipe and fittings according to the following requirements and Division 21 sections specifying piping systems.

B. Piping and Tubing: Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Cleaning: Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.05 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. General: Refer to Division 05 50 00, Section “Metal Fabrications” for structural steel.

B. Support: Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.06 GROUTING

A. General: Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Preparation: Clean surfaces that will come into contact with grout.

C. Forming: Provide forms as required for placement of grout.

D. Grout Placement: Avoid air entrapment during placement of grout.

E. Equipment Bases: Place grout, completely filling equipment bases.

F. Placement: Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Anchors: Place grout around anchors.

H. Curing: Cure placed grout.

3.07 WARRANTIES

A. Length: See Section 1-05.10 and 1-06.5, Warranties and General Conditions.

B. Submittal: Submit with O & M Manual written guarantees that exceed one year.

C. Includes: All material and labor to repair or replace defective items within any system, and extends to material and labor required to repair adjacent surfaces disturbed by malfunction.

D. Does Not Include: Replacement of components that malfunction due to abuse, lack of proper maintenance, or improper operation by Contracting Agency.

3.08 HEAD PROTECTION

A. Padding: Where pipe, hangers, equipment support angles, etc. are exposed in walkways or accessways to equipment for maintenance purposes, cover all such potentially injurious protrusions less than 7.00 feet above walking surface with padding. Secure padding permanently.

3.09 COORDINATION OF WORK

A. Rough In: Insure proper “rough-in” for all equipment and fixtures to which connections are made, including Contracting Agency-furnished and/or -installed equipment and fixtures.

B. Exposed Systems: Fire-suppression piping and sprinkler heads in exposed areas (areas without hung ceilings) shall have no visible defects from a distance of 5.00 feet. Piping and appurtenances shall be installed plumb and rectilinear to room surfaces. Hangers and seismic bracing shall be installed in a symmetrical fashion. Show all routing, fittings, proposed seams, and hanger locations on Shop Drawings for review.

C. Interferences:
   1. Coordinate Work to ensure that there is not a conflict between location of sprinkler piping and heads, electric fixtures, piping, ducts, etc. Sprinkler piping and head locations shall not limit or prohibit access to mechanical or electrical accessories requiring maintenance access.
   2. Vertical shafts have been provided for the express purpose of routing mechanical and electrical services. Space has been assigned for mechanical and electrical services to be installed as part of this Work. In addition, space for future expansion and addition of other mechanical and electrical systems has been allocated. Fire Sprinkler Contractor is not to assume that space (either vertical or horizontal) is available for fire sprinkler piping, valves, or accessories in these shafts. Unless specifically shown on Drawings, Fire Sprinkler Contractor's design shall route all fire sprinkler services so as not to violate shaft space.

3.10 LAYOUT

A. General: All areas of building are to be fully sprinklered including any areas above ceilings or any voids required to formally meet requirements of applicable codes and standards and authorities having jurisdiction.

B. Design Coordination: Coordinate location, type, and quantity of heads; type of coverage with architectural reflected ceiling plan; and requirements of authorities having jurisdiction. Locate piping in such a manner that it will not interfere with lights, structure, etc. Changes in layout, to meet requirements of applicable codes and standards and authorities having jurisdiction, shall be made without additional cost to Contracting Agency.

C. Sprinkler Head Locations: Where sprinkler heads are installed in acoustical ceiling tiles, they shall be centered in tile unless indicated otherwise on architectural reflected ceiling plans. Where multiple sprinkler heads occur in a linear pattern, intent is to have sprinkler heads in a straight line, without variation. Additionally, vertical height of installed heads shall be uniform and per manufacturer's recommendations. Sprinkler head locations are indicated on the architectural reflected ceiling plans only in areas of aesthetic importance. If head locations or number of heads indicated do not comply with applicable codes and standards or requirements of authorities having jurisdiction, revise the locations and number of heads, and obtain approval from Contracting Agency prior to formal submittal.

3.11 EXISTING UTILITIES

A. General: Existing utility lines are indicated on Drawings in accordance with available information from Contracting Agency. Contact all applicable utility companies and utility districts (telephone, electrical power company, local gas company, local water and sewer districts, etc.) prior to starting any work in order to confirm if there are any utilities not shown on the Drawings or in different locations than those shown on the Drawings. If an existing utility is disrupted, coordinate repairs with utility Contracting Agency at no additional cost to Contracting Agency. Abandon existing underground utility lines not required for service.

3.12 PRECAUTIONS AGAINST FREEZING

A. Method: Where up to six sprinkler heads are located in areas that are subject to freezing temperature, heads shall be dry pendent type in lieu of a dry pipe system. All wet piping shall be in a heated space. Where over six sprinkler heads are subject to freezing, a dry pipe system shall be installed.

3.13 GUARDS

A. Locations: Provide where clear height under sprinkler head is less than 7.00 feet above floor or maintenance walkways.

3.14 COMPRESSED AIR SOURCE

A. Compressed Air Source: Compressed air for dry pipe and preaction systems shall be provided from new Contractor-furnished compressor.

3.15 IDENTIFICATION

A. General: See Division 21 05 53.

3.16 PAINTING

A. Preparation and Application: Conform to requirements of Section 09 90 00 "Painting and Coating."

B. Scope: Paint work and equipment as itemized below.

U[illegible]	**C[illegible]**	**C[illegible] C[illegible] C[illegible]N[illegible].**
Fire Service	Red	342

1. Fire Service: Fire service piping is further defined as wet, dry, or standpipe systems connected to or served by building's fire protection system. Painting of fire service piping, equipment, and valves shall encompass wet and dry systems, including standpipes exposed to view (not behind architectural surfaces). Fire service piping includes, but is not limited to, fire service piping exposed in mechanical spaces, machine rooms, fan rooms, and stair towers, both heated and non-heated spaces of project. Painting shall not include piping in shafts, concealed above architectural ceilings, or other concealed spaces. Do not paint sprinkler heads or other items as defined by NFPA to remain unpainted.

C. Material and Application: Clean and thoroughly prepare surfaces prior to painting. Apply two coats of high-grade approved alkyd resin paint. Apply paint in accordance with manufacturer's instructions.

3.17 TESTS

A. Method: Test piping system in accordance with NFPA 13, 14, and 20 requirements. Certify that these tests have been satisfactorily conducted. Include copies of all test results in O & M Manual.

END OF SECTION 21 05 00

This page intentionally left blank

SECTION 21 05 53

IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment labels.

B. Warning signs and labels.

C. Pipe labels.

D. Stencils.

E. Valve tags.

F. Warning tags.

1.02 RELATED REQUIREMENTS

A. Section 21 05 00, “Common Work Results for Fire Suppression” for additional requirements for this Section.

B. Unless otherwise required by this specification, conform to the requirements of ASME/ANSI A13.1. Where label backgrounds and lettering colors are not specifically called out in these Contract Documents, conform to requirements of ASME/ANSI A13.1.

C. Unless specified otherwise, all piping systems and equipment shown on Contract Documents, or provided by the Fire Protection Contractor, shall be labeled to comply with ASME/ANSI A13.1 and NFPA.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

D. Valve Numbering Scheme: Provide

E. Valve Schedules: Valve numbering scheme.

1.04 COORDINATION

A. Finished Surfaces: Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Access Panel Locations: Coordinate installation of identifying devices with locations of access panels and doors.

C. Scheduling: Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: stainless steel, 0.025 inch thick, with predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2.50 by 0.75 inch.
5. Minimum Letter Size: 0.25 inch for name of units if viewing distance is less than 24.00 inches, 0.50 inch for viewing distances up to 72.00 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 0.125 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 degrees F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2.50 by 0.75 inch.
6. Minimum Letter Size: 0.25 inch for name of units if viewing distance is less than 24.00 inches, 0.50 inch for viewing distances up to 72.00 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment-Label Schedule: For each item of equipment to be labeled, on 8.50-by-11.00-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 0.125 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 degrees F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2.50 by 0.75 inch.

F. Minimum Letter Size: 0.25 inch for name of units if viewing distance is less than 24.00 inches, 0.50 inch for viewing distances up to 72.00 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.03 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.

B. Pre-Tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; pipe size; and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1.50 inches high.

E. Pipe-Label Colors:
   1. Background Color: Red.
   2. Letter Color: White.

2.04 VALVE TAGS

A. Valve Tags: Stamped or engraved with 0.25-inch letters for piping system abbreviation and 0.50-inch numbers.
   1. Tag Material: Brass, 0.032-inch**,** Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. For each piping system, on 8.50-by-11.00-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.

2.05 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: 3.00 by 5.25 inches minimum.
   2. Fasteners: Reinforced grommet and wire or string.
   3. Nomenclature: Large-size primary caption such as “DANGER,” “CAUTION,” or “DO NOT OPERATE.”
   4. Color: Yellow background with black lettering.

PART 3 EXECUTION

3.01 PREPARATION

A. Cleaning: Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 LABEL INSTALLATION

A. Covering and Painting Coordination: Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Access Panel and Door Locations: Coordinate installation of identifying devices with locations of access panels and doors.

C. Mechanical Equipment: Install or permanently fasten labels on each major item of mechanical equipment.

D. Equipment labels: Locate equipment labels where accessible and visible.

E. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50.00 feet along each run. Reduce intervals to 25.00 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.03 VALVE-TAG INSTALLATION

A. Required Tag Locations: Install tags on valves and control devices in piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in “Valve-Tag Size and Shape” Subparagraph below:
   1. Valve-Tag Size and Shape:
      a. Fire-Suppression Standpipe: 2.00 inches, round.
      b. Wet-Pipe Sprinkler System: 2.00 inches, round.
      c. Dry-Pipe Sprinkler System: 2.00 inches, round.
      d. Foam-Water System: 2.00 inches, round.
      e. Clean-Agent Fire-Extinguishing System: 2.00 inches, round.

3.04 WARNING-TAG INSTALLATION

A. General: Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 21 05 53

SECTION 21 13 13

WET-PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipes, fittings, and specialties.

B. Fire-protection valves.

C. Fire-department connections.

D. Sprinklers.

E. Alarm devices.

F. Manual control stations.

G. Control panels.

H. Pressure gauges.

1.02 RELATED REQUIREMENTS

A. Section 21 13 16 “Dry-Pipe Sprinkler Systems” for dry-pipe sprinkler piping.

B. Section 21 05 00, “Common Work Results for Fire Suppression”

1.03 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.04 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

B. Deluge Sprinkler System: Open sprinklers are attached to piping connected to water supply through deluge valve. Fire-detection system, in same area as sprinklers, opens valve. Water flows into piping system and discharges from attached sprinklers when valve opens.

1.05 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Available fire-hydrant flow test records indicate the following conditions:
    a. Performed by: Kitsap PUD
    b. Location of Residual Fire Hydrant R: Bond and Lamird road
    c. Static Pressure at Residual Fire Hydrant R:131 psig.
    d. Available fire flow 1695 GPM.

C. Sprinkler System Design: Sprinkler system design shall be reviewed and approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:
    a. Automobile Parking Areas: Ordinary Hazard, Group 1.
    b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    c. General Storage Areas: Ordinary Hazard, Group 1.
    d. Machine Shops: Ordinary Hazard, Group 2.
    e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    f. Office and Public Areas: Light Hazard.
    g. Repair Garages: Ordinary Hazard, Group 2.

h. Solvent Cleaning Areas: Extra Hazard, Group 2.

3. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Light-Hazard Occupancy: 0.10 gpm over 1,500-sq ft area.
   b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1,500-sq ft area.
   c. Ordinary-Hazard, Group 2 Occupancy: 0.15 gpm over 1,500-sq ft area.
   d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2,500-sq ft area.
   e. Extra-Hazard, Group 2 Occupancy: 0.30 gpm over 2,500-sq ft area.
   f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
4. Maximum Protection Area per Sprinkler: Per UL listing.
5. Maximum Protection Area per Sprinkler:
   a. According to NFPA 13 recommendations unless otherwise indicated.
6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.06 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Qualification Data: For qualified Installer.

E. Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been reviewed and approved by authorities having jurisdiction, including hydraulic calculations if applicable.
   1. Sprinklers shall be referred to on Drawings, submittals, and other documentation by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

F. Welding Certificates: Provide.

G. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include “Contractor’s Material and Test Certificate for Aboveground Piping.”

H. Field Quality-Control Reports: Provide.

I. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer’s responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire hydrant flow test.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. All grooved joint couplings, fittings, valves, and specialties shall be of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
   1. All castings used for fittings, couplings, valve bodies, etc., shall include a cast date stamp for quality assurance and traceability.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13, “Installation of Sprinkler Systems.”
   2. NFPA 24, “Installation of Private Fire Service Mains and Their Appurtenances.”

1.08 COORDINATION

A. Ceiling Coordination: Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.09 EXTRA MATERIALS

A. Spare Parts: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. General: Comply with requirements in “Piping Schedule” Specification for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.02 STEEL PIPE AND FITTINGS

A. Standard Weight, Black Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.

D. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

G. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Victaulic.
      b. Anvil.
   2. Pressure Rating: 175 psig minimum.
   3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 536, ductile-iron casting; with dimensions matching steel pipe. Short pattern with flow equal to standard-pattern fittings.
   4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
      a. Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with NFPA-13.Installation ready rigid coupling for direct stab installation without field disassembly.
         1) Couplings shall be fully installed at visual pad-to-pad offset contact. Tongue and recess type couplings or couplings that require exact gapping of bolt pads at specific torque ratings are not permitted.
      b. Flexible Type: Use in locations where vibration attenuation and stress relief are required.

2.03 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic and asbestos free.
   1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
   2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Grooved Joint Lubricants: Lubricate gasket in accordance with the manufacturer's published instructions using lubricant that is suitable for the fluid media and gasket elastomer.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493, solvent cement recommended by pipe and fitting manufacturer, and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.

G. Plastic, Pipe-Flange Gasket, and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.04 LISTED FIRE-PROTECTION VALVES

A. General Requirements:
   1. Valves shall be UL listed or FM approved.
   2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
   3. Minimum Pressure Rating for High-Pressure Piping: 250 psig

B. Ball Valves:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Victaulic.
      b.
   2. Standard: UL 1091 except with ball instead of disc.
   3. Valves NPS 1-1/2 and Smaller: Bronze or brass body with grooved or threaded ends.
   4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
   5. Valves NPS 3: Ductile-iron body with grooved ends.
   6. Weatherproof actuator housing with supervisory switches.

C. Bronze Butterfly Valves:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Milwaukee.
      b. Victaulic.
   2. Standard: UL 1091.
   3. Pressure Rating: 175 psig.
   4. Body Material: Bronze.
   5. End Connections: Threaded or copper-tube dimensioned grooved ends.

D. Iron Butterfly Valves:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Milwaukee.
      b. NIBCO.
      c. Victaulic.
   2. Standard: UL 1091.
   3. Pressure Rating: 300 psig.
   4. Body Material: Cast or ductile iron.
   5. Style: Lug or wafer.
   6. End Connections: Grooved.

7. Stem shall be offset from the disc centerline to allow complete 360-degree circumferential seating.
8. Seat shall be pressure responsive.
9. Weatherproof actuator housing with supervisory switches.

E. Check Valves:
1. Products: Subject to compliance with requirements, provide one of the following:
a. NIBCO.
b. Victaulic.
c. Viking.
d. Watts.
2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum
4. Type: Swing check. Spring assisted for vertical or horizontal installation.
5. Body Material: Cast ductile iron.
6. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Crane.
b. Milwaukee.
c. NIBCO.
2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

G. Iron OS&Y Gate Valves:
1. Products: Subject to compliance with requirements, provide one of the following:
a. NIBCO.
b. Victaulic.
c. Watts.
2. Standard: UL 262.
3. Pressure Rating:250 psig minimum
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

H. Indicating-Type Butterfly Valves:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Milwaukee.
b. NIBCO.
c. Victaulic.
2. Standard: UL 1091.
3. Pressure Rating: 300 psig minimum.
4. Valves NPS 2 and Smaller:
a. Valve Type: Ball or butterfly.
b. Body Material: Bronze.
c. End Connections: Threaded or grooved.
d. Stem shall be offset from the disc centerline to allow complete 360 degree circumferential seating.
e. Seat shall be pressure responsive.
5. Valves NPS 2-1/2 and Larger:
a. Valve Type: Butterfly.
b. Body Material: Cast or ductile iron.
c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Weatherproof actuator housing. Integral electrical, 115-V ac, prewired, single-circuit, supervisory switches indicating device.

2.05 TRIM AND DRAIN VALVES

A. General Requirements:
   1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   2. Pressure Rating: 175 psig minimum.

B. Angle Valves:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Fire Protection Products.
      b. United Brass Works.

C. Ball Valves:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. NIBCO.
      b. Victaulic.
      c. Watts.

D. Globe Valves:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Fire Protection Products.
      b. United Brass Works.
      c.

2.06 SPECIALTY VALVES

A. General Requirements:
   1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   2. Pressure Rating:
      a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
      b. High-Pressure Piping Specialty Valves: 250 psig minimum
   3. Body Material: Cast or ductile iron.
   4. Size: Same as connected piping.
   5. End Connections: Flanged or grooved.

B. Alarm Valves:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Victaulic.
      b. Viking.
   2. Standard: UL 193.
   3. Design: For vertical installation.
   4. Internal components shall be replaceable without removing the valve from the installed position.
   5. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.
   6. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.

C. Automatic (Ball Drip) Drain Valves:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Reliable.
      b. Tyco.
   2. Standard: UL 1726.
   3. Pressure Rating: 175 psig minimum.
   4. Type: Automatic draining, ball check.
   5. Size: NPS 3/4.
   6. End Connections: Threaded.

2.07 FIRE-DEPARTMENT CONNECTIONS

A. Exposed-Type, Fire-Department Connection:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Fire Protection Products.
      b. Guardian.
      c. Tyco.
   2. Standard: UL 405.
   3. Type: Exposed, projecting, for wall mounting.
   4. Pressure Rating: 175 psig minimum.
   5. Body Material: Corrosion-resistant metal.
   6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
   7. Caps: Brass, lugged type, with gasket and chain.
   8. Escutcheon Plate: Round, brass, wall type.
   9. Outlet: Back, with pipe threads.
   10. Number of Inlets: Three.
   11. Escutcheon Plate Marking: Similar to “AUTO SPKR.”
   12. Finish: Rough brass or bronze.
   13. Outlet Size: NPS 6.

2.08 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Victaulic.
      b. Anvil.
   2. Standard: UL 213.
   3. Pressure Rating: 175 psig minimum
   4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
   5. Type: Mechanical-T and -cross fittings.
   6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
   7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
   8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. AGF.
      b. Victaulic.
   2. Standard: UL’s “Fire Protection Equipment Directory” listing or “Approval Guide,” published by FM Global, listing. NFPA 13.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material:
      a. Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
      b. Or bronze body, brass stem, impregnated Teflon seat, chrome-coated brass ball, and a steel handle with positive stops at the TEST and DRAIN positions.
   5. Test Orifice Size: As required by NFPA 13, latest edition.

C. Pressure Relief Valve and Drainage Piping:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. AGF.
   2. Pressure Rating: Factory rated at 175 psi.
   3. Body Material: Bronze body and stainless steel spring.
   4. Components: Flexible tube, two .050-inch NPT elbows, external identification plate and integral flushing handle.
   5. 0.50-inch inlet and outlet.

6. Relief pressure shall be factory set to project requirements.
7. Relief valve shall operate to the OPEN position between 90 and 105 percent of the set pressure.
8. Relief valve shall reseat or CLOSE at a minimum of 80 percent of set pressure.
9. Locking plate kit to prevent accidental alarm activation by locking the valve handle in the "off" position.
10. Size: Same as connected piping.
11. Inlet and Outlet: Threaded or grooved ends.

D. Sprinkler Inspector's Test Fittings:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Victaulic.
b. Viking.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Flexible, Sprinkler Hose Fittings:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Victaulic VicFlex.
b. FlexHead Industries.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175 psig minimum.
5. Size: Same as connected piping, for sprinkler.
6. The drop shall include a UL-approved Series AH2 braided hose with a bend radius to 2.00 inches to allow for proper installation in confined spaces. The hose shall be listed for 4 bends at 31.00-inch length
7. Union joints shall be provided for ease of installation. The flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB1 bracket. The bracket shall allow installation before the ceiling tile is in place.

2.09 SPRINKLERS

A. Products: Subject to compliance with requirements, provide one of the following:
1. Reliable.
2. Tyco.
3. Victaulic.
4. Viking.

B. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
4. Sprinkler body shall be integrally cast with a hex-shaped wrench boss to reduce the risk of damage during installation. Wrenches shall be provided by the sprinkler manufacturer that directly engage the wrench boss. (Sprinklers shall not contain rubber O-rings.)

C. Automatic Sprinklers with Heat-Responsive Element:
1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 0.50-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:
   1. Chrome plated.
   2. Bronze.
   3. Painted.

E. Special Coatings:
   1. Corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   1. Ceiling Mounting: Chrome-plated steel, one piece, flat
   2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Reliable.
      b. Tyco.
      c. Victaulic.
      d. Viking.
   2. Standard: UL 199.
   3. Type: Wire cage with fastening device for attaching to sprinkler.

H. Guards and escutcheons: Shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

2.10 ALARM DEVICES

A. Types: Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Victaulic.
      b. Viking.
   2. Standard: UL 753.
   3. Type: Mechanically operated, with Pelton wheel.
   4. Alarm Gong: Cast aluminum with red-enamel factory finish.
   5. Size: 10.00-inch diameter.
   6. Components: Shaft length, bearings, and sleeve to suit wall construction.
   7. Inlet: NPS 3/4.
   8. Outlet: NPS 1 drain connection.

C. Water-Flow Indicators:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Potter Electric Signal Company.
      b. System Sensor.
      c. Viking.
      d. Watts.
   2. Standard: UL 346.
   3. Water-Flow Detector: Electrically supervised.
   4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
   5. Type: Paddle operated.
   6. Pressure Rating: 250 psig.
   7. Design Installation: Horizontal or vertical.

D. Pressure Switches:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Potter Electric Signal Company.

b. System Sensor.
c. Tyco.
d. Viking.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

E. Valve Supervisory Switches:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Fire-Lite Alarms.
b. System Sensor.
c. Kennedy.
d. Potter Electric Signal Company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

F. Indicator-Post Supervisory Switches:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Potter Electric Signal Company.
b. System Sensor.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.11 PRESSURE GAUGES

A. Products: Subject to compliance with requirements, provide one of the following:
1. AGF.
2. Dwyer
3. Marsh
4. Palmer
5. Trerice
6. Weiss

B. Standard: UL 393. NFPA 13.

C. Dial Size: 3.50- to 4.50-inch diameter.

D. Pressure Gauge Range: 0 to 250 psig minimum.

E. Water System Piping Gauge: Include “WATER” or “AIR/WATER” label on dial face.

F. Air System Piping Gauge: Include retard feature and “AIR” or “AIR/WATER” label on dial face.

PART 3 EXECUTION

3.01 PREPARATION

A. Fire Hydrant Flow Test: Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in “Quality Assurance” Specification.

B. Test Results: Report test results promptly and in writing.

3.02 SERVICE-ENTRANCE PIPING

A. Connection Requirements: Connect sprinkler piping to water-service piping for service entrance to building.

B. Additional Requirements: Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-service piping.

C. Additional Requirements: Install shutoff valve, check valve, pressure gauge, and drain at connection to water service.

3.03 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Contracting Agency before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Seismic Restraints: Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.

D. Listed Fittings: Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Unions: Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Grooved End Piping Valves: Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Inspector's Test Connection: Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. System Drainage: Install sprinkler piping with drains for complete system drainage.

I. Sprinkler Piping Connected to Standpipes: Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Drain Valve at Check Valve: Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

K. Alarm Devices: Install alarm devices in piping systems.

L. Hangers and Supports: Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

M. Pressure Gauges: Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with soft metal-seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.

N. System Fill: Fill sprinkler system piping with water.

O. Sleeves: Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

P. Sleeve Seals: Install sleeve seals for piping penetrations of concrete walls and slabs.

Q. Escutcheons: Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.04 JOINT CONSTRUCTION

A. Finish and Pressure Ratings: Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Unions: Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Grooved End Piping Valves: Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Pipe Ends: Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Initial Pipe Cleaning: Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel Piping, Pressure-Sealed Joints: Join light-wall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to “Quality Assurance” Specification.
   1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints and in accordance with the manufacturer’s published instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be verified as suitable for the intended service prior to installation. Gaskets shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer’s factory-trained representative shall provide on-site training for contractor’s field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer’s representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

L. Steel Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints and in accordance with the manufacturer’s published instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be verified as suitable for the intended service prior to installation. Gaskets shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer’s factory-trained representative shall provide on-site training for contractor’s field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer’s representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

M. Steel Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

N. Brazed Joints: Join copper tube and fittings according to CDA’s “Copper Tube Handbook,” “Brazed Joints” Chapter.

O. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints and in accordance with the manufacturer’s published instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be verified as suitable for the intended service prior to installation. Gaskets shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer’s factory-trained representative shall provide on-site training for contractor’s field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer’s representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

P. Copper Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.

Q. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

R. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

S. Plastic Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3.05 VALVE AND SPECIALTIES INSTALLATION

A. NFPA 13 Requirements: Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Supervised Fire Protection Valves: Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Check Valves: Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
   1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
   2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.
   3. Deluge Valves: Install in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.

3.06 SPRINKLER INSTALLATION

A. Ceilings: Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Dry Type Sprinklers: Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Flexible Sprinkler Hose Fittings: Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

D. Do not install sprinklers that have been dropped or show a visible loss of fluid. Never install sprinklers with cracked bulbs.

E. Sprinkler bulb protector must remain in place until the sprinkler is completely installed and before the system is placed in service. Remove bulb protectors carefully by hand after installation. Do not use any tools to remove bulb protectors.

3.07 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Wall Type Fire Department Connections Install wall-type, fire-department connections.

B. Yard Type Fire Department Connections: Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Section 03 30 00 “Cast-in-Place Concrete.”
   1. Install three protective pipe bollards around each fire-department connection. Comply with requirements for bollards in Section 05 50 00 “Metal Fabrications.”

C. Drain Valve at Check Valve: Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.08 IDENTIFICATION

A. Labeling and Pipe Markers: Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identification for Electrical Systems: Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 “Identification for Electrical Systems.”

3.09 FIELD QUALITY CONTROL

A. Tests and Inspections: Perform tests and inspections.

B. Test and Inspection Requirements: Tests and Inspections:
   1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Flush, test, and inspect sprinkler systems according to NFPA 13, “Systems Acceptance” Chapter.
   4. Energize circuits to electrical equipment and devices.
   5. Coordinate with fire-alarm tests. Operate as required.
   6. Coordinate with fire-pump tests. Operate as required.
   7. Verify that equipment hose threads are same as local fire-department equipment.

C. Defective Results: Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Reports: Prepare test and inspection reports.

3.10 CLEANING

A. Sprinklers: Clean dirt and debris from sprinklers.

B. Paint: Remove and replace sprinklers with paint other than factory finish.

3.11 DEMONSTRATION

A. Training: Train Contracting Agency’s maintenance personnel to adjust, operate, and maintain the system.

3.12 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Specialty Fittings: Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Extruded Tee Connections: Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.

D. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 and Smaller: Shall be one of the following:
   1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   3. Standard-weight, black-steel pipe with cut- or roll- grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

E. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 to NPS 4: Shall be one of the following:
   1. iron threaded fittings; and threaded joints.
   2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

3. Standard-weight, black-steel pipe with cut- or roll- grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

F. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 5 and Larger: Shall be one of the following:
   1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   3. Standard-weight, black-steel pipe with cut- or roll- grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.13 SPRINKLER SCHEDULE

A. Sprinkler Types: Use sprinkler types in subparagraphs below for the following applications:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended Ceilings: Recessed sprinklers.
   3. Wall Mounting: Sidewall sprinklers.
   4. Spaces Subject to Freezing: Upright sprinklers.
   5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.

B. Sprinkler Type Finishes: Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
   2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
   3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
   4. Residential Sprinklers: Dull chrome.
   5. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 13 13

This page intentionally left blank

SECTION 21 13 16
DRY-PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipes, fittings, and specialties.

B. Fire-protection valves.

C. Fire-department connections.

D. Sprinkler specialty pipe fittings.

E. Sprinklers.

F. Alarm devices.

G. Manual control stations.

H. Control panels.

I. Pressure gauges.

1.02 RELATED REQUIREMENTS

A. Section 21 13 13 “Wet-Pipe Sprinkler Systems” for wet-pipe sprinkler piping.

B. Section 21 05 00 “Common Work Results for Fire Suppression.”

1.03 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure 175 psig maximum.

1.04 SYSTEM DESCRIPTIONS

A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.

1.05 PERFORMANCE REQUIREMENTS

A. See 21 13 13 “Wet-Pipe Sprinkler Systems” for performance requirements.

B. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.06 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.07 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Domestic water piping.
   2. Compressed air piping.
   3. HVAC hydronic piping.
   4. Items penetrating finished ceiling including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.

B. Qualification Data: For qualified Installer.

C. Reviewed Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been reviewed by authorities having jurisdiction, including hydraulic calculations if applicable.
   1. Sprinklers shall be referred to on Drawings, submittals, and other documentation by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

D. Fire-Hydrant Flow Test Report: Provide.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include “Contractor’s Material and Test Certificate for Aboveground Piping.”

F. Field Quality-Control Reports: Provide.

1.08 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.09 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Materials: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.10 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer’s responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. All grooved joint couplings, fittings, valves, and specialties shall be of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
   1. All castings used for fittings, couplings, valve bodies, etc., shall include a cast date stamp for quality assurance and traceability.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13, “Installation of Sprinkler Systems.”
   2. NFPA 13R, “Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height.”
   3. NFPA 24, “Installation of Private Fire Service Mains and Their Appurtenances.”

1.11 COORDINATION

A. Ceilings: Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. Piping Schedule: Comply with requirements in “Piping Schedule” Specification for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 STEEL PIPE AND FITTINGS

A. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized, Steel Couplings: ASTM A 865, threaded.

D. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Victaulic.
      b. Anvil
   2. Pressure Rating: 175 psig minimum.
   3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 536, ductile-iron casting; with dimensions matching steel pipe. Short pattern, with flow equal to standard-pattern fittings.
   4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
      a. Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with NFPA 13. Installation-ready rigid coupling for direct stab installation without field disassembly.
         1) Couplings shall be fully installed at visual pad-to-pad offset contact. Tongue and recess type couplings or couplings that require exact gapping of bolt pads at specific torque ratings are not permitted.
      b. Flexible Type: Use in locations where vibration attenuation and stress relief are required.

2.03 LISTED FIRE-PROTECTION VALVES

A. See 21 13 13 “Wet-Pipe Sprinkler Systems” for allowable valves.

2.04 TRIM AND DRAIN VALVES

A. See 21 13 13 “Wet-Pipe Sprinkler Systems” for trim and drain valves.

2.05 SPECIALTY VALVES

A. General Requirements:
   1. Standard: UL’s “Fire Protection Equipment Directory” listing or “Approval Guide,” published by FM Global, listing.
   2. Pressure Rating:
      a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
   3. Body Material: Cast or ductile iron.
   4. Size: Same as connected piping.
   5. End Connections: Flanged or grooved.

B. Dry-Pipe Valves:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Victaulic.
      b. Viking.
      c. Tyco
   2. Standard: UL 260
   3. Design: Low differential-pressure type.
   4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.

5. Required air pressure shall be 13 psi.
6. Valve shall be externally resettable.
7. Internal components shall be replaceable without removing the valve from the installed position.
8. Air-Pressure Maintenance Device:
    a. Products: Subject to compliance with requirements, provide one of the following:
        1) Victaulic.
        2) Viking.
        3) Tyco
    b. Standard: UL 260.
    c. Type: Automatic device to maintain minimum air pressure in piping.
    d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.

C. Air Compressor:
1. Products: Subject to compliance with requirements, provide one of the following:
    a. Gast.
    b. Victaulic.
    c. Viking.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Motor Horsepower: Fractional.
4. Power: 120-V ac, 60 Hz, single phase.

2.06 FIRE-DEPARTMENT CONNECTIONS

A. See 21 13 13 "Wet-Pipe Sprinkler Systems" for fire department connections

2.07 SPRINKLER SPECIALTY PIPE FITTINGS

A. See 21 13 13 "Wet-Pipe Sprinkler Systems" for specialty pipe fittings

2.08 SPRINKLERS

A. See 21 13 13 "Wet-Pipe Sprinkler Systems" for sprinklers.

2.09 ALARM DEVICES

A. See 21 13 13 "Wet-Pipe Sprinkler Systems" for alarm devices.

2.10 MANUAL CONTROL STATIONS

A. Description: UL listed or FM Global approved, hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.11 CONTROL PANELS

A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
1. Panels: UL listed and FM Global approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
2. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.12 PRESSURE GAUGES

A. See 21 13 13 “Wet-Pipe Sprinkler Systems” for pressure gauges.

PART 3 EXECUTION

3.01 PREPARATION

A. Fire Hydrant Flow Test: Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in “Quality Assurance” Specification.

B. Test Results: Report test results promptly and in writing.

3.02 SERVICE-ENTRANCE PIPING

A. See 21 13 13 “Wet-Pipe Sprinkler Systems” for service entrance piping.

3.03 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   1. Deviations from Contract Documents for piping require written approval from authorities having jurisdiction. File written approval with Contracting Agency before deviating from Contract Documents.

B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.

C. Seismic Restraints: Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.

D. Fittings: Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Unions: Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Grooved End Piping Valves: Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Inspector’s Test Connection: Install “Inspector’s Test Connections” in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. System Drainage: Install sprinkler piping with drains for complete system drainage.

I. Sprinkler Piping Connected to Standpipes: Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Piping Between Fire Department Connections and Check Valves: Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.

K. Air Compressor Piping and Wiring: Connect air compressor to the following piping and wiring:
   1. Pressure gauges and controls.
   2. Electrical power system.
   3. Fire-alarm devices, including low-pressure alarm.

L. Alarm Devices: Install alarm devices in piping systems.

M. Hangers and Supports: Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.

N. Pressure Gauges: Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with soft metal-seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.

O. Dry Pipe Sprinkler Piping: Drain dry-pipe sprinkler piping.

P. Dry Pipe Sprinkler System Pressure Check: Pressurize and check dry-pipe sprinkler system piping and compressors

Q. Sleeves: Install sleeves for piping penetrations of walls, ceilings, and floors.

R. Escutcheons: Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.04 JOINT CONSTRUCTION

A. See 21 13 13 “Wet-Pipe Sprinkler Systems” for joint construction.

3.05 VALVE AND SPECIALTIES INSTALLATION

A. NFPA 13 Requirements: Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Fire Protection Shutoff Valves: Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Check Valves: Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
   1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
   2. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
      a. Install air compressor and compressed-air supply piping.

3.06 SPRINKLER INSTALLATION

A. See 21 13 13 “Wet-Pipe Sprinkler Systems” for sprinkler installation.

3.07 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. See 21 13 13 “Wet-Pipe Sprinkler Systems” for fire department connection installation.

3.08 IDENTIFICATION

A. Labeling and Pipe Markers: Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.09 FIELD QUALITY CONTROL

A. Tests and Inspections: Perform tests and inspections.

B. Tests and Inspection Requirements:
   1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Flush, test, and inspect sprinkler systems according to NFPA 13, “Systems Acceptance” Chapter.
   4. Energize circuits to electrical equipment and devices.
   5. Start and run air compressors.
   6. Coordinate with fire-alarm tests. Operate as required.
   7. Coordinate with fire-pump tests. Operate as required.
   8. Verify that equipment hose threads are same as local fire-department equipment.

C. Defective Results: Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Reports: Prepare test and inspection reports.

3.10 CLEANING

A. Sprinklers: Clean dirt and debris from sprinklers.

B. Paint: Remove and replace sprinklers with paint other than factory finish.

3.11 DEMONSTRATION

A. Training:Train Contracting Agency's maintenance personnel to adjust, operate, and maintain specialty valves.

3.12 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Specialty Fittings: Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-Pressure, Dry-Pipe Sprinkler System, NPS 2 and Smaller: Shall be one of the following:
   1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   2. Standard-weight, galvanized-steel pipe with plain ends; plain-end-pipe fittings; and twist-locked joints.
   3. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

D. Standard-Pressure, Dry-Pipe Sprinkler System, NPS 2-1/2 to NPS 4: Shall be one of the following:
   1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

E. Standard-Pressure, Dry-Pipe Sprinkler System, NPS 5 and NPS 6: Shall be one of the following:
   1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe.

3.13 SPRINKLER SCHEDULE

A. Types: Use sprinkler types in subparagraphs below for the following applications:
   1. Spaces Subject to Freezing: Upright sprinklers

B. Finishes: Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
   2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
   3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
   4. Upright Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 13 16

This page intentionally left blank

SECTION 22 00 00
GENERAL PLUMBING REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE

A. Basic plumbing requirements specifically applicable to Division 22 Sections.

B. Edit content to match project scope

C. Work includes but is not necessarily limited to the following:

D. Labor, materials, services, equipment, and appliances required for completion of tasks as indicated on drawing or in specification or as inherently necessary to prepare spaces and systems for new installations as follows:
   1. Plumbing systems and equipment

1.02 DRAWINGS AND SPECIFICATIONS

A. Drawings accompanying these Specifications show intent of Work to be done. Specifications shall identify quality and grade of installation and where equipment and hardware is not particularly specified, Contractor shall provide submittals for all products and install them per manufacturers' recommendations, and in a first class manner.

B. Examine Drawings and Specifications for elements in connection with this Work; determine existing and new general construction conditions and be familiar with all limitations caused by such conditions.

C. Plans are intended to show general arrangement and extent of Work contemplated. Exact location and arrangement of parts shall be determined after the Contracting Agency has reviewed equipment, as Work progresses, to conform in best possible manner with surroundings, and as directed by the Contracting Agency.

D. Contract Documents are in part diagrammatic and intended to show the scope and general arrangement of the Work under this Contract. The Contractor shall follow these drawings in laying out the equipment, piping and ductwork. Drawings are not intended to be scaled for roughing in measurements or to serve as shop drawings. Where job conditions require minor changes or adjustments in the indicated locations or arrangement of the Work, such changes shall be made without change in the Contract amount.

E. Follow dimensions without regard to scale. Where no figures or notations are given, the Plans shall be followed.

1.03 UTILITIES

A. Location and sizes of electrical, mechanical and plumbing service facilities are shown in accordance with data secured from existing record drawings and site observations. Data shown are offered as an estimating guide without guarantee of accuracy. Check and verify all data given, and verify exact location of all utility services pertaining to Work prior to excavation or performing Work.

1.04 APPLICABLE REFERENCE STANDARDS, CODES AND REGULATIONS

A. Meet requirements of all state codes having jurisdiction.

B. State of Washington Code of Regulations:
   1. 2018 International Building Code
   2. 2018 Uniform Plumbing Code
   3. 2018 Washington State Energy Code

C. Additional Referenced Standards:
   1. ASME American Society of Mechanical Engineers
   2. ASTM American Society for Testing and Materials
   3. NEMA National Electrical Manufacturer's Association
   4. NFPA National Fire Protection Association Standards
   5. PDI Plumbing and Drainage Institute

6. UL Underwriters Laboratories

D. Codes and ordinances having jurisdiction over Work are minimum requirements; but, if Contract Documents indicate requirements, which are in excess of those minimum requirements, then requirements of the Contract Documents shall be followed. Should there be any conflicts between Contract Documents or codes or any ordinances having jurisdiction, report these to the Contracting Agency.

E. Obtain permits, and request inspections from authority having jurisdiction.

1.05 PROJECT AND SITE CONDITIONS

A. The arrangement of and connection to equipment shown on the drawings is based upon information available and is not intended to show exact dimensions peculiar to a specific manufacturer. The Drawings are, in part, diagrammatic and some features of the illustrated equipment installations may require revision to meet actual equipment installation requirements. Structural supports, housekeeping pads, piping connections and adjacent equipment may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions or alterations.

B. Examine all Drawings and Specifications to be fully cognizant of all work required under this Division.

C. Examine site related work and surfaces before starting work of any Section.

D. Install Work in locations shown on approved Drawings, unless prevented by Project conditions.

E. Prepare shop drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission from the Contracting Agency before proceeding.

F. Plumbing Contractor shall be fully responsible to survey all underground utilities prior to installation of any utilities.

G. Beginning work of any Section constitutes acceptance of conditions.

H. All connections to site piping shall be done by the plumbing contractor.

I. All work shall be performed in a clean and workmanlike manner. Care shall be exercised to minimize any inconvenience or disturbance to other areas of the building which are to remain in operation. Isolate work areas by means to keep dust and dirt within the construction area.

J. All piping into stem walls and footings shall be double half lap wrapped with 1/8” thick “Armaflex” insulation. The contractor shall also provide blocked out areas in stem wall and footing. All piping shall avoid the lower 8” of the footing.

K. All existing piping damaged during construction shall be repaired with materials to match existing by the contractor.

1.06 COOPERATION WITH WORK UNDER OTHER DIVISIONS

A. Cooperate with other trades to facilitate general progress of Work. Allow all other trades every reasonable opportunity for installation of their work.

B. Work under this Division shall follow general building construction closely. Set pipe sleeves and inserts and verify that openings for chases and pipes are provided.

C. Work with other trades in determining exact location of outlets, pipes, and pieces of equipment to avoid interference with lines required to maintain proper installation of Work.

D. Make such progress in the Work to not delay work of other trades.

E. Coordinate with electrical contractor prior to ordering equipment for available voltages at all equipment locations.

F. Mechanical Work shall have precedence over the other in the following sequence:
1. Soil and waste piping
2. Hydronic piping
3. Ductwork
4. Fire sprinkler piping

5. Domestic water piping

1.07 DISCREPANCIES

A. The Contractor shall check all Drawings furnished him immediately upon their receipt and shall promptly notify the Contracting Agency of any discrepancies. Figures marked on Drawings shall in general be followed in preference to scale measurements. Piping and instrumentation diagrams shall in general govern floor plans and sections. Large-scale drawings shall in general govern small-scale drawings.

B. Where requirements between Drawings and Specifications conflict, the more restrictive provisions shall apply.

C. If any part of the Specifications or Drawings appears unclear or contradictory, apply to Contracting Agency for interpretation and decision as early as possible, including during bidding period. Do not proceed with such work without Contracting Agency Representatives decision. Beginning work of any Section constitutes acceptance of conditions.

1.08 CHANGES

A. The Contractor shall be responsible to make and obtain approval from the Contracting Agency for all necessary adjustments in piping and equipment layouts as required to accommodate the relocations of equipment and/or devices, which are affected by any approved authorized changes or Product substitutions. All changes shall be clearly indicated on the "Record" drawings.

1.09 SUBMITTALS

A. Refer to Section 1.06 for additional requirements.

B. The manufacturer, contractor or supplier shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of that particular specification section.

C. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section.

D. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

E. Note that prior to acceptance of submittals for review, a submittal schedule shall be submitted to the Contracting Agency.

F. Submit all division 22 shop drawings and product data grouped and referenced by the specification technical section numbers in one complete submittal package. Individual or partial submittals are not acceptable and will be returned without review.

G. Shop Drawings:
   1. Provide all shop drawings in latest version of Revit/AutoCAD format and PDF format.
   2. Drawings shall be a 30 inches by 42 inches in size with a minimum scale of 1/4-inch per foot, except as specified otherwise.
   3. Include installation details of equipment indicating proposed location, layout and arrangement, accessories, piping, and other items that must be shown to assure a coordinated installation.
   4. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
   5. If equipment is disapproved, revise drawings to show acceptable equipment and resubmit.
   6. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Contracting Agency bearing the Contracting Agency stamp of "Reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the Contracting Agency without additional compensation.

H. Whenever more than one manufacturer’s product is specified, the first named product is the basis of design used in the Work and the use of alternate-named manufacturer’s products or substitutes may require modifications in that design.

I. Proposed Products List: Include Products as required by the individual section in this Division.

J. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Contracting Agency bearing the Contracting Agency stamp of "Reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the Contracting Agency without additional compensation.

K. Manufacturer's Data: For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, certified equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.

L. Standard Compliance: When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or American Water Works Association (AWWA), submit proof of such conformance to the Contracting Agency Representative for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the Contracting Agency Representative. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.

M. Certified Test Reports: Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.

N. Certificates of Compliance or Conformance: Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this Contract. Pre-printed certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; or "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance or conformance.

1.10 PROJECT RECORD DOCUMENTS

A. Refer to Section 1.05.5(2) for additional requirements.

1. All changes, deviations and information recorded on the “Project Record Drawings” set during Construction shall be marked on the “Project Record Drawings,” in red ink.

1.11 PRODUCT ALTERNATIVES OR SUBSTITUTIONS

A. Refer to General Conditions and Division 01 for additional requirements.

1.12 OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel.

1.13 MANUFACTURER S RECOMMENDATIONS

A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

1.14 DELIVERY AND STORAGE

A. Refer to Division 01 for additional requirements.

B. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B P, Appendix I, titled "Equipment

Storage and Maintenance During Construction." Replace damaged or defective items with new items.

1.15 GUARANTEE

A. Except as may be specified under other sections in the Specifications, guarantee all equipment furnished under the Specifications for a period of one year from date of project acceptance against defective workmanship and material and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the Contracting Agency.

B. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Contracting Agency for their service agency as directed.
1.

PART 2 PRODUCTS

A. Not Applicable.

PART 3 EXECUTION

3.01 GENERAL

A. Obtain and pay for all permits and inspections, including any independent testing required to verify standard compliance, and deliver certificates for same to the Contracting Agency.

3.02 WORK RESPONSIBILITIES

A. The drawings indicate diagrammatically the desired locations or arrangement of piping, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions.

B. The Contractor is responsible for the correct placing of Work and the proper location and connection of Work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.

C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without extra cost, providing the change is ordered before the ductwork, piping, etc. and work directly connected to same is installed and no extra materials are required.

D. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.

E. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.

F. Should any changes to the Work indicated on the Drawings or described in the Specifications be necessary in order to comply with the above requirements, notify the Contracting Agency immediately and cease work on all parts of the contract, which are affected until approval for any required modifications to the construction has been obtained from the Contracting Agency.

G. Be responsible for any cooperative work, which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the Contracting Agency and shall be made to his satisfaction. Perform all Work with competent and skilled personnel.

H. All work, including aesthetic as well as mechanical aspects of the Work, shall be of the highest quality consistent with the best practices of the trade.

I. Replace or repair, without additional compensation, any work, which, in the opinion of the Contracting Agency, does not comply with these requirements.

3.03 PAINTING

A. Refer to Section 09 90 00 "Painting and Coating" for additional requirements.

B. Factory Applied:
   1. Plumbing equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.
   2. Refer to individual sections of this Division for more stringent requirements.

C. Field Applied:
   1. Paint all plumbing equipment as required to touch up, to match finish on other equipment in adjacent spaces or to meet safety criteria.
   2. Paint all exposed plumbing piping, valves, supports, hangers and appurtenances. Provide minimum 5 mils dry film thickness.
   3. Paint shall be a high performance polyurethane enamel coating system.
   4. Acceptable primer manufacturers include:
   5. Ameron Amershield VOC, Tnemec's Series 1075 (1074) Endura-Shield, semi-gloss (gloss) sheen or equal.
   6. Acceptable paint manufacturers include:
   7. Ameron, Tnemec or engineer approved equal.

END OF SECTION 22 00 00

SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping materials and installation instructions common to most piping systems.

B. Dielectric fittings.

C. Transition fittings.

D. Mechanical sleeve seals.

E. Sleeves.

F. Escutcheons.

G. Grout.

H. Plumbing demolition.

I. Equipment installation requirements common to equipment sections.

J. Concrete bases.

K. Supports and anchorages.

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. ABS: Acrylonitrile-butadiene-styrene plastic.
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PE: Polyethylene plastic.
   4. PVC: Polyvinyl chloride plastic.

1.03 SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

C. Welding certificates.
   1. Welding certificates.
   2. Product Information for approval before purchase
   3. Operation and Maintenance Manuals

1.04 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.06 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 PRODUCTS

2.01 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

C. All plumbing pipe, tube and fittings shall be manufactured exclusively in the United States.

2.02 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals:

Conform to AWS A5.8.
Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
Use 15% silver brazing filler metal without flux.

F. Welding Filler Metals: Comply with AWS D10.12. for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:
   1. ABS Piping: ASTM D 2235.
   2. CPVC Piping: ASTM F 493.
   3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
   4. PVC to ABS Piping Transition: ASTM D 3138.

2.03 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.04 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
   2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   3. Pressure Plates: Stainless steel. Include two for each sealing element.
   4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.05 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.06 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

2.07 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve

seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   5. PVC Nonpressure Piping: Join according to ASTM D 2855.
   6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.03 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.04 EQUIPMENT INSTALLATION – COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.05 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.06 ERECTION OF METAL SUPPORTS AND ANCHORAGES.

A. Refer to Division 05 Section 05 50 00 "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.07 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 22 05 00

This page intentionally left blank

SECTION 22 05 17

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sleeves.

B. Stack-sleeve fittings.

C. Sleeve-seal systems.

D. Sleeve-seal fittings.

E. Grout.

F. Silicone sealants.

1.02 RELATED REQUIREMENTS

A. Section 22 00 00 “General Plumbing Requirements.”

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.

PART 2 PRODUCTS

2.01 SLEEVES

A. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized, with plain ends and integral welded water stop collar.

B. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.02 STACK-SLEEVE FITTINGS

A. Manufactured, cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with setscrews.

2.03 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Thunderline Modular Seals; Link-Seal
   2. Metraflex Co.
   3. Advance Products & Systems, Inc.

B. Description:
   1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   2. Designed to form a hydrostatic seal of 20 psig minimum.
   3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   4. Pressure Plates: Stainless steel.
   5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.
   6. Link-Seal shall be the basis of design.

2.04 GROUT

A. Description: Non-shrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.05 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 EXECUTION

3.01 SLEEVE INSTALLATION

A. Sleeves are not required for core-drilled holes, except where spill control is required

B. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

C. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes

D. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
   2. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
   3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

E. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

F. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

3.02 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.
   1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Use silicone sealant to seal the space around outside of stack-sleeve fittings.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 07 84 00 "Firestopping."

3.03 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.04 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position water stop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Use grout to seal the space around outside of sleeve-seal fittings.

3.05 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Exterior Concrete Walls above Grade:
   a. Piping Smaller Than NPS 6: Galvanized Steel pipe sleeves.
   b. Piping NPS 6 and Larger: Galvanized Steel pipe sleeves .
2. Exterior Concrete Walls below Grade:
   a. Piping Smaller Than NPS 6: Galvanized Steel pipe sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   b. Piping NPS 6and Larger: Galvanized Steel pipe sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
   a. Piping Smaller Than NPS 6: Galvanized steel pipe sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   b. Piping NPS 6 and Larger: Galvanized steel pipe sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
   a. Piping Smaller Than NPS 6: Steel pipe sleeves.
   b. Piping NPS 6 and Larger: Steel pipe sleeves.
5. Interior Partitions:
   a. Piping Smaller Than NPS 6: Steel pipe sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION 22 05 17

This page intentionally left blank

SECTION 22 05 18
ESCUTCHEONS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Escutcheons.

B. Floor plates.

1.02 RELATED REQUIREMENTS

A. Section 22 00 00 “General Plumbing Requirements.”

1.03 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. BrassCraft Manufacturing Co.; a Masco company.
   2. Keeney Manufacturing Company (The).
   3. Mid-America Fittings, Inc.

2.02 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; hinge; and spring-clip fasteners.

2.03 FLOOR PLATES

A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.

b. Chrome-Plated Piping: One-piece cast brass with polished, chrome-plated finish.
c. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
g. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
h. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.
i. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
j. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
k. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. New Piping: One-piece, floor plate.

3.02 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 22 05 18

SECTION 22 05 19

METERS AND GAGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bimetallic-actuated thermometers.

B. Filled-system thermometers.

C. Thermowells.

D. Dial-type pressure gages.

E. Gage attachments.

F. Test plugs.

1.02 RELATED REQUIREMENTS

A. Section 22 11 19 "Domestic Water Piping Specialties" for water meters.

B. Section 22 15 13 "General-Service Compressed-Air Piping" for compressed air gages.

1.03 RELATED DOCUMENTS

A. Section 22 00 00 “General Plumbing Requirements.”

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.

1.05 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage from manufacturer.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers
   1. Ashcroft Commercial Inc.
   2. Trerice, H. O. Co.
   3. Weiss Instruments, Inc.
   4. Or approved equal.

B. Standard: ASME B40.200.

C. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in degrees F and degrees C.

E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

F. Connector Size: 1/2 inch, with ASME B1.1 screw thread.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Double strength glass.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus, or minus 1 percent of scale range.

2.02 FILLED-SYSTEM THERMOMETERS

A. Manufacturers
   1. Ashcroft Commercial Inc.
   2. Trerice, H. O. Co.
   3. Weiss Instruments, Inc.
   4. Or approved equal.

B. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
   1. Standard: ASME B40.200.
   2. Case: Sealed type, cast aluminum; 4-1/2-inch nominal diameter.
   3. Element: Bourdon tube or other type of pressure element.
   4. Movement: Mechanical, with link to pressure element and connection to pointer.
   5. Dial: Nonreflective aluminum with permanently etched scale markings graduated in degrees F.
   6. Pointer: Dark-colored metal.
   7. Window: Double strength glass.
   8. Ring: Stainless steel.
   9. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
   10. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
      a. Design for Thermowell Installation: Bare stem.
   11. Accuracy: Plus or minus 1 percent of scale range.

2.03 THERMOWELLS

A. Thermowells:
   1. Standard: ASME B40.200.
   2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
   3. Material for Use with Copper Tubing: CNR or CUNI.
   4. Material for Use with Steel Piping: CRES.
   5. Type: Stepped shank unless straight or tapered shank is indicated.
   6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
   7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
   8. Bore: Diameter required to match thermometer bulb or stem.
   9. Insertion Length: Length required to match thermometer bulb or stem.
   10. Lagging Extension: Include on thermowells for insulated piping and tubing.
   11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.04 PRESSURE GAGES

A. Manufacturers
   1. Ashcroft Commercial Inc.
   2. Trerice, H. O. Co.
   3. Weiss Instruments, Inc.
   4. Or approved equal.

B. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
   1. Standard: ASME B40.100.
   2. Case: Liquid-filled type(s); cast aluminum; 4-1/2-inch nominal diameter.
   3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
   4. Pressure Connection: Brass, with NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
   5. Movement: Mechanical, with link to pressure element and connection to pointer.
   6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
   7. Pointer: Dark-colored metal.
   8. Window: Double strength glass.
   9. Ring: Stainless steel.
   10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.05 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass ball, with NPS 1/2, ASME B1.20.1 pipe threads.

2.06 TEST PLUGS

A. Description: Test-station fitting made for insertion into piping tee fitting.

B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

C. Thread Size: NPS 1/2, ASME B1.20.1 pipe thread.

D. Minimum Pressure and Temperature Rating: 500 psig at 200 degrees F.

E. Core Inserts: EPDM self-sealing rubber.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Provide remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Provide direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Provide valve and snubber in piping for each pressure gage for fluids.

J. Provide test plugs in piping tees.

K. Provide thermometers in the following locations:
   1. Inlet and outlet of each water heater.
   2. Inlets and outlets of each domestic water heat exchanger.
   3. Inlet and outlet of each domestic hot-water storage tank.
   4. Inlet and outlet of each remote domestic water chiller.

L. Provide pressure gages in the following locations:
   1. Building water service entrance into building.
   2. Inlet and outlet of each pressure-reducing valve.

3. Suction and discharge of each domestic water pump.

3.02 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.03 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.04 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
   1. Liquid-filled, bimetallic-actuated type.

B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:
   1. Liquid-filled, bimetallic-actuated type.

C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:
   1. Liquid-filled, bimetallic-actuated type.

D. Thermometer stems shall be of length to match thermowell insertion length.

3.05 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 degrees F.

B. Scale Range for Domestic Cold-Water Piping: 0 to 150 degrees F.

C. Scale Range for Domestic Cold-Water Piping: 30 to 240 degrees F.

D. Scale Range for Domestic Hot-Water Piping: 0 to 250 degrees F.

E. Scale Range for Domestic Hot-Water Piping: 20 to 240 degrees F.

F. Scale Range for Domestic Hot-Water Piping: 30 to 240 degrees F.

G. Scale Range for Domestic Cooled-Water Piping: 0 to 100 degrees F.

H. Scale Range for Domestic Cooled-Water Piping: 0 to 150 degrees F.

3.06 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be one of the following:
   1. Liquid-filled, direct-mounted, metal case.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
   1. Liquid-filled, direct-mounted, metal case.

C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:
   1. Liquid-filled, direct-mounted, metal case.

3.07 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 100 psi.

B. Scale Range for Water Service Piping: 0 to 160 psi.

C. Scale Range for Water Service Piping: 0 to 200 psi.

D. Scale Range for Domestic Water Piping: 0 to 100 psi.

E. Scale Range for Domestic Water Piping: 0 to 160 psi.

F. Scale Range for Domestic Water Piping: 0 to 200 psi.

G. Scale Range for Domestic Water Piping: 0 to 300 psi.

END OF SECTION 22 05 19

SECTION 22 05 23

GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Brass ball valves.

B. Bronze ball valves.

C. Bronze lift check valves.

D. Bronze swing check valves.

E. Bronze gate valves.

F. CPVC ball vawlves.

G. CPVC swing check valves.

H. Chainwheels.

1.02 RELATED REQUIREMENTS

A. Section 22 00 00 “General Plumbing Requirements.”

1.03 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of valve.
   1. Certification that products comply with NSF 61and NSF 372.

C. The Manufacturer, Contractor or Supplier Shall Include A Written Statement That The Submitted Equipment, Hardware Or Accessory Complies With The Requirement Of This Particular Specification Section.
   1. The Manufacturer Shall Resubmit This Specification Section Showing Compliance with Each Respective Paragraphs and Specified Items And Features.
   2. All Exceptions Shall Be Clearly Identified by Referencing Respective Paragraph And Other Requirements Along With Proposed Alternative.
   3. Individual or Partial Submittals Are Not Acceptable and Will Be Returned Without Review.

1.05 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
ASME B31.1 for power piping valves.
ASME B31.9 for building services piping valves

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, and soldered ends.
   3. Protect threads, flange faces, grooves, and weld ends.
   4. Set ball valves open to minimize exposure of functional surfaces.
   5. Set check valves in either closed or open position.
   6. Set gate valves closed to prevent rattling.
   7. Set butterfly valves closed or slightly open.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.5 for flanges on steel valves.
   4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   5. ASME B16.18 for solder-joint connections.
   6. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. RS Valves in Insulated Piping: With 2-inch stem extensions.

H. Valve Sizes: Same as upstream piping unless otherwise indicated.

I. Valve Bypass and Drain Connections: MSS SP-45.

J. Valve Actuator Types:
   1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
   2. Handlever: For quarter-turn valves smaller than NPS 6.
   3. Chainwheel: Device for attachment to gear, handlever, or stem; of size and with chain for mounting height, according to "Valve Installation" Article.

K. Valves in Insulated Piping:
   1. Include 2-inch stem extensions.
   2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
   3. Memory stops that are fully adjustable after insulation is applied.

2.02 BRONZE BALL VALVES

A. Bronze Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. NIBCO INC.
      c. WATTS.
   2. Description:
      a. Standard: MSS SP-110 or MSS-145.
      b. CWP Rating: 600 psig.
      c. Body Design: Two piece.
      d. Body Material: Bronze.
      e. Ends: Threaded or soldered.
      f. Seats: PTFE.
      g. Stem: Stainless steel.
      h. Ball: Stainless steel, vented.
      i. Port: Full.

2.03 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. NIBCO INC.
      c. Stockham; Crane Energy Flow Solutions.
   2. Description:
      a. Standard: MSS SP-80, Type 3.
      b. CWP Rating: 200 psig.
      c. Body Design: Horizontal flow.
      d. Body Material: ASTM B 62, bronze.
      e. Ends: Threaded or soldered. See valve schedule articles.
      f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Crane; Crane Energy Flow Solutions.
      c. NIBCO INC.
   2. Description:
      a. Standard: MSS SP-80, Type 4.
      b. CWP Rating: 200 psig.
      c. Body Design: Horizontal flow.
      d. Body Material: ASTM B 62, bronze.
      e. Ends: Threaded or soldered. See valve schedule articles.
      f. Disc: PTFE.

C. Bronze Swing Check Valves with Bronze Disc, Class 150:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Crane; Crane Energy Flow Solutions.

c. NIBCO INC.

2. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 300 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: Bronze.

D. Bronze Swing Check Valves with Nonmetallic Disc, Class 150:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Crane; Crane Energy Flow Solutions.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
2. Description:
   a. Standard: MSS SP-80, Type 4.
   b. CWP Rating: 300 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: PTFE.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

F. Check Valves: Install check valves for proper direction of flow.
1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

G. Install chainwheels on operators for gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

3.03 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If ball valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
   4. For Grooved-End Copper Tubing and Steel Piping: Grooved.

C. If check valve applications are not indicated, use the following:
   1. Pump-Discharge Check Valves:
      a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
      b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; or iron, center-guided, metal-seat or resilient-seat check valves.
      c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

D. Use gate valves for shutoff service only.

3.05 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Brass ball valve, one piece. Provide with threaded, press or solder-joint ends.
   2. Bronze ball valve, one piece with bronze or stainless-steel trim. Provide with threaded or solder-joint ends.
   3. Brass ball valves, two-piece with full-port and brass or stainless-steel trim. Provide with threaded or solder-joint ends.
   4. Bronze ball valves, two-piece with full-port and bronze, brass or stainless-steel trim. Provide with threaded or solder-joint ends.
   5. Brass ball valves, three-piece with full port and brass or stainless-steel trim.
   6. Bronze ball valves, three-piece with full port and stainless-steel trim.
   7. Bronze ball valves, two-piece with regular port and bronze or stainless-steel trim.
   8. Bronze swing check valves with bronze disc, Class 125 or Class 150, with soldered or threaded end connections.
   9. Bronze gate valves, NRS, RS, Class 125 or Class 150 with soldered or threaded ends.

B. Pipe NPS 2-1/2 and Larger:
   1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
   2. Steel ball valves, Class 150 with full-port.
   3. Iron ball valves, Class 150.
   4. Iron swing check valves with metal seats, Class 125 or Class 250, with threaded or flanged end connections.
   5. Iron swing check valves with closure control lever and spring or weight, Class 125, with threaded or flanged end connections.
   6. Iron, grooved-end swing check valves, 300 CWP.
   7. Iron, center-guided check valves with compact wafer, Class 125, Class 150, Class 250 or Class 300.
   8. Iron, center-guided check valves with globe, metal, resilient seat, Class 125, Class 150, Class 250 or Class 300, with threaded or flanged end connections.
   9. Iron, dual-plate check valves with metal, resilient seat, Class 125, Class 150, Class 250 or Class 300, with threaded or flanged end connections.

10. Iron, single-plate check valves with resilient seat, Class 125 or Class 250, with threaded or flanged end connections.
11. Iron gate valves, NRS, OS&Y, Class 125 or Class 250 with flanged ends.
12. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM or NBR seat, aluminum-bronze, ductile-iron or stainless-steel disc.
13. Ductile-Iron, Grooved-End Butterfly Valves: 175 or 300 CWP.

END OF SECTION 22 05 23

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal pipe hangers and supports.

B. Trapeze pipe hangers.

C. Metal framing systems.

D. Thermal hanger-shield inserts.

E. Fastener systems.

F. Pipe stands.

G. Pipe-positioning systems.

H. Equipment supports.

1.02 RELATED REQUIREMENTS

A. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

B. Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment"

1.03 RELATED DOCUMENTS

A. Section 21 05 00 "Common Work Results For Fire Suppression Systems."

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product indicated including component cut-sheets and pre-approved details.
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
   2. Environmental Product Declaration: For each product.
   3. Health Product Declaration: For each product.
   4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
   1. Trapeze pipe hangers.
   2. Metal framing systems.
   3. Pipe stands.
   4. Equipment supports.

D. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of trapeze hangers.
   2. Include design calculations for designing trapeze hangers.

1.05 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.06 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.02 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
   3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel stainless steel.

B. Stainless-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe and Tube Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
   2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel stainless steel.

2.03 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.04 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. B-line, an Eaton business.
      b. Flex-Strut Inc.
      c. Unistrut; Part of Atkore International.
   2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.

3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel stainless-steel, Type 304 stainless-steel, Type 316 extruded-aluminum Insert material channel with inturned lips.
5. Channel Width: Selected for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel stainless steel.
8. Metallic Coating: No coating Plain Pregalvanized G90 Electroplated zinc Hot-dip galvanized Gold (yellow zinc dichromate) galvanized.
9. Paint Coating: Green epoxy, acrylic, or urethane.
10. Plastic Coating: PVC.
11. Combination Coating: .

B. Non-MFMA Manufacturer Metal Framing Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International.
   b. PHD Manufacturing, Inc.
   c. Sioux Chief Manufacturing Company, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel stainless-steel channel with inturned lips.
5. Channel Width: Select for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel stainless steel.
8. Metallic Coating: No coating Plain Pregalvanized G90 Hot-dip galvanized
9. Paint Coating: Green epoxy, acrylic, or urethane.
10. Plastic Coating: PVC.

2.05 THERMAL HANGER-SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. National Pipe Hanger Corporation.
2. Pipe Shields Inc.
3. Piping Technology & Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psig ASTM C552, Type II cellular glass with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.06 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Hilti, Inc.
      b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
      c. Simpson Strong-Tie Co., Inc.

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. B-line, an Eaton business.
      b. Hilti, Inc.
      c. ITW Ramset/Red Head; Illinois Tool Works, Inc.
   2. Indoor Applications: Zinc-coated or stainless steel.
   3. Outdoor Applications: Stainless steel.

2.07 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand:
   1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
   2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
   3. Hardware: Galvanized steel or polycarbonate.
   4. Accessories: Protection pads.

C. Low-Profile, Single-Base, Single-Pipe Stand:
   1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
   2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
   3. Vertical Members: Two galvanized stainless-steel, continuous-thread, 1/2-inch rods.
   4. Horizontal Member: Adjustable horizontal, galvanized stainless-steel pipe support channels.
   5. Pipe Supports: Roller Strut clamps Clevis hanger Swivel hanger.
   6. Hardware: Galvanized Stainless steel.
   7. Accessories: Protection pads.
   8. Height: 12 inches above roof.

D. High-Profile, Single-Base, Single-Pipe Stand:
   1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   2. Base: Single vulcanized rubber or molded polypropylene.
   3. Vertical Members: Two galvanized stainless-steel, continuous-thread, 1/2-inch rods.
   4. Horizontal Member: One adjustable-height, galvanized- or stainless-steel, pipe-support slotted channel or plate.
   5. Pipe Supports: Roller Clevis hanger Swivel hanger.
   6. Hardware: Galvanized Stainless steel.
   7. Accessories: Protection pads, 1/2-inch, continuous-thread, galvanized-steel rod, 1/2-inch, continuous-thread, stainless-steel rod.
   8. Height: 36 inches above roof.

E. High-Profile, Multiple-Pipe Stand:
   1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
   2. Bases: Two or more; vulcanized rubber molded polypropylene.
   3. Vertical Members: Two or more, galvanized stainless-steel channels.
   4. Horizontal Members: One or more, adjustable-height, galvanized stainless-steel pipe support.
   5. Pipe Supports: Roller Strut clamps Clevis hanger Swivel hanger.
   6. Hardware: Galvanized Stainless steel.
   7. Accessories: Protection pads, 1/2-inch, continuous-thread rod.
   8. Height: 36 inches above roof.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.08 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.09 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.10 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Non-staining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 APPLICATION

A. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.02 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

F. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Pipe Stand Installation:
   1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
   2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 07 72 00 "Roof Accessories" for curbs.

H. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

N. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

P. Insulated Piping:
   1. Attach clamps and spacers to piping.
      a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.06 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 09 90 00 "Painting and Coating."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.07 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal hanger-shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
   7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
   11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
   12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
   13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
   14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
   15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
   16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
   17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
   18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
   19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.

20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary, to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

SECTION 22 05 48

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Elastomeric isolation pads.

B. Elastomeric isolation mounts.

C. Restrained elastomeric isolation mounts.

D. Open-spring isolators.

E. Housed-spring isolators.

F. Restrained-spring isolators.

G. Housed-restrained-spring isolators.

H. Pipe-riser resilient supports.

I. Resilient pipe guides.

J. Elastomeric hangers.

K. Spring hangers.

L. Snubbers.

M. Restraint channel bracings.

N. Restraint cables.

O. Seismic-restraint accessories.

P. Mechanical anchor bolts.

Q. Adhesive anchor bolts.

1.02 RELATED REQUIREMENTS

A. Section 22 05 48 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.

B. Section 22 05 48 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.03 RELATED DOCUMENTS

A. Section 22 00 00 “General Plumbing Requirements.”

1.04 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.05 ACTION SUBMITTALS

A. Submittals shall be formatted per 0000 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:

1. “No Exception Taken”.
2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction.
   b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

C. Shop Drawings:
1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

D. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
4. Seismic-Restraint Details:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
   d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Field quality-control reports.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
   1. Site Class as Defined in the IBC: D
   2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.
      a. Component Importance Factor: 1.0.
      b. Component Response Modification Factor: See Drawing S0.1 for Criteria.
      c. Component Amplification Factor: See Drawing S0.1 for Criteria
   3. Design Spectral Response Acceleration at Short Periods (0.2 Second): See Drawing S0.1 for Criteria
   4. Design Spectral Response Acceleration at 1.0-Second Period: See Drawing S0.1 for Criteria
   5. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction.
      a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.02 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ace Mountings Co., Inc.
      b. California Dynamics Corporation.
      c. Isolation Technology, Inc.
   2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
   3. Size: Factory or field cut to match requirements of supported equipment.
   4. Pad Material: Oil and water resistant with elastomeric properties.
   5. Surface Pattern: Smooth Ribbed Waffle pattern.
   6. Infused nonwoven cotton or synthetic fibers.
   7. Load-bearing metal plates adhered to pads.
   8. Sandwich-Core Material: Resilient and elastomeric.
      a. Surface Pattern: Smooth Ribbed Waffle pattern.
      b. Infused nonwoven cotton or synthetic fibers.

2.03 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. B-line, an Eaton business.
   2. CADDY; a brand of nVent.
   3. TOLCO.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections Reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.04 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. B-line, an Eaton business.
   2. Hilti, Inc.
   3. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.05 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hilti, Inc.
   2. Kinetics Noise Control, Inc.
   3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in 3000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in 7200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

D. Equipment Restraints:
   1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
   2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
   3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction that provides required submittals for component.

E. Piping Restraints:
   1. Comply with requirements in MSS SP-127.
   2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
   3. Brace a change of direction longer than 12 feet.

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction that provides required submittals for component.

H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

K. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer's recommended torque, using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in 1116 "Domestic Water Piping" for piping flexible connections.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   2. Schedule test with Contracting Agency, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
   3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
   4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
   5. Test to 90 percent of rated proof load of device.
   6. Measure isolator restraint clearance.
   7. Measure isolator deflection.
   8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.06 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 22 05 48

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment labels.

B. Warning signs and labels.

C. Pipe labels.

D. Stencils.

E. Valve tags.

F. Warning tags.

1.02 RELATED DOCUMENTS

A. Section 22 00 00 “General Plumbing Requirements.”

ACTION SUBMITTALS

B. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

C. Product Data: For each type of product indicated.

D. Samples: For color, letter style, and graphic representation required for each identification material and device.

E. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

F. Valve numbering scheme.

G. Valve Schedules: For each piping system to include in maintenance manuals.

1.03 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

1.04 GENERAL

A. Manufacturers:
   1. Craftmark Identification Systems
   2. Seton Identification Products
   3. Setmark

PART 2 PRODUCTS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brady Corporation.
      b. Marking Services, Inc.
      c. Seton Identification Products.

2. Material and Thickness: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Red.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Marking Services, Inc.
   c. Seton Identification Products.
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Red.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation.
2. Marking Services, Inc.
3. Seton Identification Products.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick and having predrilled holes for attachment hardware.

C. Letter Color: Black.

D. Background Color: Yellow.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.03 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
   2. Brady Corporation.
   3. Seton Identification Products.

B. Do not use pipe labels or plastic tapes for bare pipes conveying fluids at temperatures of 125 deg F (52 deg C) or higher.

C. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.04 STENCILS

A. Stencils for Piping:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brimar Industries, Inc.
      b. Marking Services, Inc.
      c. Seton Identification Products.
   2. Lettering Size: Size letters according to ASME A13.1 for piping.
   3. Stencil Material: Brass.
   4. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
   5. Identification Paint: Exterior, alkyd enamel or acrylic enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

2.05 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
   2. Brady Corporation.
   3. Brimar Industries, Inc.

B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link chain or beaded chain or S-hook.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.

2.06 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation.
   2. Brimar Industries, Inc.
   3. Carlton Industries, LP.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7 inches.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   4. Color: Safety yellow background with black lettering.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surface of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.03 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.04 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 09 90 00 "Painting and Coating."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
   1. Identification Paint: Use for contrasting background.
   2. Stencil Paint: Use for pipe marking.

C. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

E. Pipe Label Color Schedule:
1. Low-Pressure Compressed Air Piping:
   a. Background: Safety blue.
   b. Letter Colors: White.
2. High-Pressure Compressed Air Piping:
   a. Background: Safety blue.
   b. Letter Colors: White.
3. Domestic Water Piping
   a. Background: Safety green.
   b. Letter Colors: White.
4. Sanitary Waste and Storm Drainage Piping:
   a. Background Color: Safety green.
   b. Letter Color: White.

3.05 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:
   a. Cold Water: 2 inches, round.
   b. Hot Water: 2 inches, round.
   c. Low-Pressure Compressed Air: 2 inches, round.
   d. High-Pressure Compressed Air: 2 inches, round.
2. Valve-Tag Colors:
   a. Cold Water: Natural.
   b. Hot Water: Natural.
   c. Low-Pressure Compressed Air: Natural.
   d. High-Pressure Compressed Air: Natural.
3. Letter Colors:
   a. Cold Water: Black White.
   b. Hot Water: Black.
   c. Low-Pressure Compressed Air: Black.
   d. High-Pressure Compressed Air: Black.

3.06 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53

This page intentionally left blank

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating the following plumbing piping services:
   1. Domestic cold-water piping.
   2. Domestic hot-water piping.
   3. Domestic recirculating hot-water piping.
   4. Domestic chilled-water piping for drinking fountains.
   5. Sanitary waste piping exposed to freezing conditions.
   6. Storm-water piping exposed to freezing conditions.
   7. Roof drains and rainwater leaders.
   8. Supplies and drains for handicap-accessible lavatories and sinks.

1.02 RELATED DOCUMENTS

A. Section 22 00 00 “General Plumbing Requirements.”

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

C. Sustainable Design Submittals:
   1. Product Data: For adhesives, mastics, and sealants, indicating VOC content.
   2. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.

D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties, equipment connections, and access panels.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.

E. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
   1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
   2. Jacket Materials for Pipe: 12 inches long by NPS 2.
   3. Sheet Jacket Materials: 12 inches square.
   4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
   1. Piping Mockups:
      a. One 10-foot section of NPS 2 straight pipe.
      b. One each of a 90-degree threaded, welded, and flanged elbow.
      c. One each of a threaded, welded, and flanged tee fitting.
      d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
      e. Four support hangers including hanger shield and insert.
      f. One threaded strainer and one flanged strainer with removable portion of insulation.
      g. One threaded reducer and one welded reducer.
      h. One pressure temperature tap.
      i. One mechanical coupling.
   2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
   3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
   4. Obtain Architect's approval of mockups before starting insulation application.
   5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   7. Demolish and remove mockups when directed.

D. Comply with the following applicable standards and other requirements specified for miscellaneous components:
   1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.07 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.08 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type I for tubular materials.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Aeroflex USA, Inc.
      b. Armacell LLC.
      c. K-Flex USA.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation.
      b. Johns Manville; a Berkshire Hathaway company.
      c. Owens Corning.

H. Mineral-Fiber, Preformed Pipe Insulation:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Johns Manville; a Berkshire Hathaway company.
      b. Manson Insulation Inc.
      c. Owens Corning.
   2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547, Type I, Grade A, with factory-applied ASJ with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Phenolic:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Resolco Inc.
2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C1126, Type III, Grade 1.
3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C1126, Type II, Grade 1.
4. Factory fabricate shapes according to ASTM C450 and ASTM C585.
5. Factory-Applied Jacket: ASJ. Requirements are specified in "Factory-Applied Jackets" Article.

2.02 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Ramco Insulation, Inc.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Ramco Insulation, Inc.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Ramco Insulation, Inc.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Aeroflex USA, Inc.
b. Armacell LLC.
c. K-Flex USA.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.
c. Eagle Bridges - Marathon Industries.
d.

D. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.

E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller Construction Products.
      c. Mon-Eco Industries, Inc.

F. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Johns Manville; a Berkshire Hathaway company.
      b. P.I.C. Plastics, Inc.
      c. Dow Corning Corporation.

2.04 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.
   1. Mastics: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.
   2. Mastics shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
   3.

B. Vapor-Retarder Mastic: Water based; suitable for indoor use on below-ambient services.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller Construction Products.
      c. Knauf Insulation.
   2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D1644, 58 percent by volume and 70 percent by weight.
   5. Color: White.

C. Vapor-Retarder Mastic: Solvent based; suitable for indoor use on below-ambient services.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller Construction Products.
      c. Eagle Bridges - Marathon Industries.
   2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
   3. Service Temperature Range: 0 to 180 deg F.
   4. Color: White.

D. Vapor-Retarder Mastic: Solvent based; suitable for outdoor use on below-ambient services.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller Construction Products.
      c. Eagle Bridges - Marathon Industries.
   2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
   3. Service Temperature Range: Minus 50 to plus 220 deg F.
   4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller Construction Products.
      c. Knauf Insulation.
      d. Vimasco Corporation.
   2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Color: White.

2.05 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
   1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller Construction Products.
      c. Vimasco Corporation.
   3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
   4. Service Temperature Range: 0 to plus 180 deg F.
   5. Color: White.

2.06 SEALANTS

A. Joint Sealants for Phenolic Products:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller Construction Products.
      c. Pittsburgh Corning Corporation.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Permanently flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 100 to plus 300 deg F.
   5. Color: White or gray.
   6. Sealant shall have a VOC content of 420 g/L or less.
   7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
   8.

B. FSK and Metal Jacket Flashing Sealants:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller Construction Products.
      c. Eagle Bridges - Marathon Industries.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.
   5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Childers Brand; H. B. Fuller Construction Products.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.
   5. Color: White.

2.07 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
   3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.08 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Childers Brand; H. B. Fuller Construction Products.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Foster Brand; H. B. Fuller Construction Products.
      b. Vimasco Corporation.

2.09 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Alpha Associates, Inc.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Johns Manville; a Berkshire Hathaway company.
      b. P.I.C. Plastics, Inc.
      c. Proto Corporation.
   2. Adhesive: As recommended by jacket material manufacturer.
   3. Color: White.
   4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ITW Insulation Systems; Illinois Tool Works, Inc.
      b. RPR Products, Inc.
   2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
      a. Factory cut and rolled to size.
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
      d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
      e. Factory-Fabricated Fitting Covers:
         1) Same material, finish, and thickness as jacket.
         2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
         3) Tee covers.
         4) Flange and union covers.
         5) End caps.
         6) Beveled collars.
         7) Valve covers.
         8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Pittsburgh Corning Corporation.
      b. Polyguard Products, Inc.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division.
      b. Ideal Tape Co., Inc., an American Biltrite Company.
      c. Knauf Insulation.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   4. Adhesion: 90 ounces force/inch in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division.
      b. Ideal Tape Co., Inc., an American Biltrite Company.
      c. Knauf Insulation.
   2. Width: 3 inches.

3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Ideal Tape Co., Inc., an American Biltrite Company.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Avery Dennison Corporation, Specialty Tapes Division.
b. Ideal Tape Co., Inc., an American Biltrite Company.
c. Knauf Insulation.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. RPR Products, Inc.
2. Stainless Steel: ASTM A167 or ASTM A240/A240M, Type 304; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy 0.062-inch soft-annealed, stainless steel 0.062-inch soft-annealed, galvanized steel.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. C & F Wire.

2.13 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. McGuire Manufacturing. (With integral insulation).
b. Or equal products.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures: (Subject to architect's approval).
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Truebro.
      b. Zurn Industries, LLC.
   2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
   2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches 4 inches o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 07 84 00 " Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 00 " Firestopping."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and

unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.07 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   4. Install insulation to flanges as specified for flange insulation application.

3.08 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:
   1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
   2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.09 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 90 00 "Painting and Coating."
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
      a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals non-compliance with requirements.

E. All adhesive shall be as recommended by cellular glass manufacturer and with a VOC content of 80 g/L or less.

F. Per ASHRAE 189.1, All adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water:
   1. NPS 3/4 and Smaller: Insulation shall be one of the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   2. NPS 1 and Larger: Insulation shall be one of the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Chilled Water (Potable):
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
      c. Phenolic: 1 inch thick.

C. Stormwater and Overflow:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Roof Drain and Overflow Drain Bodies:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

E. Sanitary Waste Piping Where Heat Tracing Is Installed:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

F. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Concealed: None.

C. Piping, Exposed: PVC, Color-Coded by system, 30 mils thick for all indoor applications.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Concealed: None.

C. Piping, Exposed: Aluminum, Stucco Embossed, 0.024 inch thick.

END OF SECTION 22 07 19

This page intentionally left blank

SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Copper tube and fittings.

B. Piping joining materials.

C. Encasement for piping.

D. Transition fittings.

E. Dielectric fittings.

1.02 RELATED DOCUMENTS

A. Section 22 00 00 “General Plumbing Requirements.”

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For transition fittings and dielectric fittings.

C. Sustainable Design Submittals:
   1. Product Data: For adhesives, indicating VOC content.
   2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

1.04 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.05 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Contracting Agency or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
   1. Notify Architect, Construction Manager and/or Contracting Agency no fewer than two days in advance of proposed interruption of water service.
   2. Do not interrupt water service without Architect's, Construction Manager's and/or Contracting Agency's written permission.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on applicable piping.

2.02 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type K water tube, drawn temper.

B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. Copper Unions:
   1. MSS SP-123.
   2. Cast-copper-alloy, hexagonal-stock body.
   3. Ball-and-socket, metal-to-metal seating surfaces.
   4. Solder-joint or threaded ends.

F. Copper, Brass, or Bronze Pressure-Seal-Joint Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Mueller Industries, Inc.
      c. NIBCO INC.
   2. Fittings: Cast-brass, cast-bronze or wrought-copper with EPDM O-ring seal in each end. Sizes NPS 2-1/2 and larger with stainless steel grip ring and EPDM O-ring seal.
   3. Minimum 200-psig working-pressure rating at 250 deg F.

G. Appurtenances for Grooved-End Copper Tubing:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Anvil International.
      b. Shurjoint-Apollo Piping Products USA Inc.
      c. Victaulic Company.
   2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75/B 75M copper tube or ASTM B 584 bronze castings.
   3. Mechanical Couplings for Grooved-End Copper Tubing:
      a. Copper-tube dimensions and design similar to AWWA C606.
      b. Ferrous housing sections.
      c. EPDM-rubber gaskets suitable for hot and cold water.
      d. Bolts and nuts.
      e. Minimum Pressure Rating: 300 psig.

2.03 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
   1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
   2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
   1. Solvent cement shall have a VOC content of 490 g/L or less.
   2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

G. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
   1. Solvent cement shall have a VOC content of 510 g/L or less.
   2. Adhesive primer shall have a VOC content of 550 g/L or less.

3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.04 TRANSITION FITTINGS

A. General Requirements:
1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Dresser, Inc.
b. Jay R. Smith Mfg. Co.
c. JCM Industries, Inc.

D. Plastic-to-Metal Transition Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Charlotte Pipe and Foundry Company.
b. Harvel Plastics, Inc.
c. Spears Manufacturing Company.
2. Description:
a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Colonial Engineering, Inc.
b. NIBCO INC.
c. Spears Manufacturing Company.
2. Description:
a. CPVC or PVC four-part union.
b. Brass or stainless-steel threaded end.
c. Solvent-cement-joint or threaded plastic end.
d. Rubber O-ring.
e. Union nut.

2.05 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Central Plastics Company.
      b. WATTS.
      c. Wilkins.
   2. Standard: ASSE 1079.
   3. Pressure Rating: 125 psig minimum at 180 deg F.
   4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Central Plastics Company.
      b. WATTS.
      c. Wilkins.
   2. Standard: ASSE 1079.
   3. Factory-fabricated, bolted, companion-flange assembly.
   4. Pressure Rating: 125 psig minimum at 180 deg F.
   5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
   2. Nonconducting materials for field assembly of companion flanges.
   3. Pressure Rating: 150 psig.
   4. Gasket: Neoprene or phenolic.
   5. Bolt Sleeves: Phenolic or polyethylene.
   6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Elster Perfection Corporation.
      b. Grinnell G-Fire by Johnson Controls Company.
      c. Precision Plumbing Products.
   2. Standard: IAPMO PS 66.
   3. Electroplated steel nipple complying with ASTM F 1545.
   4. Pressure Rating and Temperature: 300 psig at 225 deg F.
   5. End Connections: Male threaded or grooved.
   6. Lining: Inert and noncorrosive, propylene.

PART 3 EXECUTION

3.01 EARTHWORK

A. Comply with requirements in Section 31 20 00 "Earthwork" for excavating, trenching, and backfilling.

3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 22 11 19 "Domestic Water Piping Specialties."

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 "Domestic Water Piping Specialties."

H. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

N. Install piping to permit valve servicing.

O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

P. Install piping free of sags and bends.

Q. Install fittings for changes in direction and branch connections.

R. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping."

S. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 11 23 "Domestic Water Pumps."

T. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 "Meters and Gages for Plumbing Piping."

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

G. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

I. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.04 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
   2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.05 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings nipples or unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits or nipples.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.06 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for hangers, supports, and anchor devices in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Vertical Piping: MSS Type 8 or 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Support piping and tubing not listed in this article according to MSS SP-58 and manufacturer's written instructions.

J. Install hangers for copper ductile iron tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

K. Install vinyl-coated hangers for CPVC and PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent. Install vinyl-coated hangers for PEX tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

L. Support horizontal piping within 12 inches of each fitting.

M. Support vertical runs of copper ductile iron tubing and piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

N. Support vertical runs of CPVC and PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.Support vertical runs of PEX tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.07 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
   2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
   4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.08 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.09 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Piping Inspections:
      a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
      b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
         1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
         2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
      c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
      d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
   2. Piping Tests:
      a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
      b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
      c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
      d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
      e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
      f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:
   1. Close drain valves, hydrants, and hose bibbs.
   2. Open shutoff valves to fully open position.
   3. Open throttling valves to proper setting.
   4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
      a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
      b. Adjust calibrated balancing valves to flows indicated.
   5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
   6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
   7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
   8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Fill and isolate system according to either of the following:
         1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
         2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
      c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      d. Repeat procedures if biological examination shows contamination.
      e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
   1. Hard copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
   2. Mechanical-joint, ductile-iron pipe; standard- or compact-pattern, mechanical-joint fittings; and mechanical joints.
   3. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

F. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

G. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed or soldered joints.
   2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

H. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed or soldered joints.
   2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
   3. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
   2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
   3. Hot-Water Circulation Piping, Balancing Duty: Calibrated or Memory-stop balancing valves.
   4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 22 11 16

SECTION 22 11 19
DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vacuum breakers.

B. Backflow preventers.

C. Water pressure-reducing valves.

D. Automatic water shutoff valves.

E. Balancing valves.

F. Temperature-actuated, water mixing valves.

G. Strainers.

H. Outlet boxes.

I. Hose bibbs.

J. Drain valves.

K. Water-hammer arresters.

L. Trap-seal primer valves.

M. Trap-seal primer systems.

N. Flexible connectors.

O. Water meters.

1.02 RELATED REQUIREMENTS

A. Section 22 00 00 “General Plumbing Requirements.”

B. Section 22 05 19 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.

C. Section 22 11 16 "Domestic Water Piping" for water meters.

D. Section 22 45 00 "Emergency Plumbing Fixtures" for water tempering equipment.

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:

1. “No Exception Taken”.
2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.

C. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on plastic piping components.

B. Comply with NSF 372 for low lead.

2.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.03 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. FEBCO; A WATTS Brand.
      c. WATTS.
      d. Zurn Industries, LLC.
   2. Standard: ASSE 1001.
   3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
   4. Body: Bronze.
   5. Inlet and Outlet Connections: Threaded.
   6. Finish: Rough bronze or Chrome plated.

B. Hose-Connection Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. WATTS.
      c. Zurn Industries, LLC.
   2. Standard: ASSE 1011.
   3. Body: Bronze, nonremovable, with manual drain.
   4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
   5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. FEBCO; A WATTS Brand.
      c. WATTS.
      d. Zurn Industries, LLC.
   2. Standard: ASSE 1020.
   3. Operation: Continuous-pressure applications.
   4. Pressure Loss: 5 psig maximum, through middle third of flow range.
   5. Size: Refer to Plumbing design drawings.
   6. Design Flow Rate: Refer to Plumbing design drawings.
   7. Selected Unit Flow Range Limits: Refer to Plumbing design drawings.
   8. Pressure Loss at Design Flow Rate:Refer to Plumbing design drawings .
   9. Accessories: Refer to Plumbing design drawings.
      a. Valves: Ball type, on inlet and outlet.

D. Laboratory-Faucet Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. WATTS.
      c. Woodford Manufacturing Company.
      d. Zurn Industries, LLC.
   2. Standard: ASSE 1035.
   3. Size: NPS 1/4 or NPS 3/8 matching faucet size.
   4. Body: Bronze.
   5. End Connections: Threaded.
   6. Finish: Chrome plated.

E. Spill-Resistant Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. WATTS.
      c. Zurn Industries, LLC.
   2. Standard: ASSE 1056.
   3. Operation: Continuous-pressure applications.
   4. Size: NPS □, NPS 3/8, NPS 1/2,, NPS 3/4or NPS 1.
   5. Accessories: Refer to Plumbing design drawings.
      a. Valves: Ball type, on inlet and outlet.

2.04 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. FEBCO; A WATTS Brand.
      c. WATTS.
      d. Zurn Industries, LLC.
   2. Standard: ASSE 1012.
   3. Operation: Continuous-pressure applications.
   4. Size: NPS 1/2or NPS 3/4.
   5. Body: Bronze.
   6. End Connections: Union, solder joint.
   7. Finish: Chrome platedor Rough bronze.

B. Reduced-Pressure-Principle Backflow Preventers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Ames Fire & Waterworks; A WATTS Brand.
      b. FEBCO; A WATTS Brand.
      c. WATTS.
      d. Zurn Industries, LLC.
   2. Standard: ASSE 1013.
   3. Operation: Continuous-pressure applications.
   4. Pressure Loss: 12 psig maximum, through middle third of flow range.
   5. Size: Refer to Plumbing design drawings.

6. Design Flow Rate: Refer to Plumbing design drawings.
7. Selected Unit Flow Range Limits: Refer to Plumbing design drawings .
8. Pressure Loss at Design Flow Rate: Refer to Plumbing design drawings .
9. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approvedor stainless steel for NPS 2-1/2 and larger.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
11. Configuration: Designed for horizontal, straight-throughor vertical-inlet, horizontal-center-section, and vertical-outlet flow.
12. Accessories:
    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check, Backflow-Prevention Assemblies:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. FEBCO; A WATTS Brand.
    c. WATTS.
    d. Zurn Industries, LLC.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size: Refer to Plumbing design drawings.
6. Design Flow Rate: Refer to Plumbing design drawings.
7. Selected Unit Flow Range Limits: Refer to Plumbing design drawings.
8. Pressure Loss at Design Flow Rate: Refer to Plumbing design drawings.
9. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approvedor stainless steel for NPS 2-1/2 and larger.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
11. Configuration: Designed for horizontal, straight-through flow.
12. Accessories:
    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

D. Beverage-Dispensing-Equipment Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. WATTS.
    c. Zurn Industries, LLC.
2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

E. Dual-Check-Valve Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    a. Apollo Flow Controls; Conbraco Industries, Inc.

b. FEBCO; A WATTS Brand.
c. WATTS.
d. Zurn Industries, LLC.
2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2, NPS 3/4, NPS 1or NPS 1-1/4.
5. Body: Bronze with union inlet.

F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Cash Acme; a division of Reliance Worldwide Corporation.
b. Lancer Corporation.
c. WATTS.
2. Standard: ASSE 1032.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

G. Reduced-Pressure-Detector, Fire-Protection, Backflow-Preventer Assemblies:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Apollo Flow Controls; Conbraco Industries, Inc.
b. FEBCO; A WATTS Brand.
c. WATTS.
d. Zurn Industries, LLC.
2. Standard: ASSE 1047 and is FM Global approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: Refer to Plumbing design drawings.
6. Design Flow Rate: Refer to Plumbing design drawings.
7. Selected Unit Flow Range Limits: Refer to Plumbing design drawings.
8. Pressure Loss at Design Flow Rate: Refer to Plumbing design drawings .
9. Body: Cast iron or steel with interior lining that complies with AWWA C550 or that is FDA approved orStainless steel.
10. End Connections: Flanged.
11. Configuration: Designed for horizontal, straight-throughor vertical-inlet, horizontal-center-section, and vertical-outlet flow.
12. Accessories: Refer to Plumbing design drawings
a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

H. Double-Check, Detector-Assembly Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Apollo Flow Controls; Conbraco Industries, Inc.
b. FEBCO; A WATTS Brand.
c. WATTS.
d. Zurn Industries, LLC.
2. Standard: ASSE 1048 and is FM Global approved or UL listed.

3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size: Refer to Plumbing design drawings.
6. Design Flow Rate: Refer to Plumbing design drawings.
7. Selected Unit Flow Range Limits: Refer to Plumbing design drawings.
8. Pressure Loss at Design Flow Rate: Refer to Plumbing design drawings.
9. Body: Cast iron or steel with interior lining that complies with AWWA C550 or that is FDA approved or Stainless steel.
10. End Connections: Flanged.
11. Configuration: Designed for horizontal, straight-through or vertical-inlet, horizontal-center-section, and vertical-outlet flow.
12. Accessories:
    a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

I. Hose-Connection Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. WATTS.
    c. Woodford Manufacturing Company.
2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

J. Backflow-Preventer Test Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. FEBCO; A WATTS Brand.
    c. WATTS.
    d. Zurn Industries, LLC.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.05 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. Cash Acme; a division of Reliance Worldwide Corporation.
    c. WATTS.
    d. Zurn Industries, LLC.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: Refer to Plumbing design drawings .
5. Design Flow Rate: Refer to Plumbing design drawings.
6. Design Inlet Pressure: Refer to Plumbing design drawings.
7. Design Outlet Pressure Setting: Refer to Plumbing design drawings.

8. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water-Control Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. CLA-VAL Automatic Control Valves.
   c. WATTS.
   d. Zurn Industries, LLC.
2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
   a. Size: Refer to Plumbing design drawings NPS.
   b. Pattern: Angleor Globe-valve design.
   c. Trim: Stainless steel.
5. Design Flow: Refer to Plumbing design drawings.
6. Design Inlet Pressure: Refer to Plumbing design drawings.
7. Design Outlet Pressure Setting: Refer to Plumbing design drawings.
8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.06 AUTOMATIC WATER SHUTOFF VALVES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. DynaQuip Controls.
2. FloLogic, Inc.
3. OnSite PRO Inc.
4. QMI Manufacturing Inc.

B. Standards: NSF 61 and NSF 372.

C. Shutoff Control Ball Valve:
1. Size: NPS 1/2, NPS 3/4, NPS 1, NPS 1-1/4, NPS 1-1/2or NPS 2.
2. Design Flow Rate: Refer to Plumbing design drawings.
3. Design Inlet Pressure: Refer to Plumbing design drawings.
4. Control Valve: Two-piece, full-port brass ball valve, MSS SP-110.
   a. End Connections: Threaded, female.
   b. Seats: PTFE.
   c. O-Rings: FKM.
   d. Stem: Low lead brass. Blowout proof.
   e. CWP Rating: 600 psig.
5. Manual override control turn-knob for emergency operation of the valve.

D. Shutoff Control Butterfly Valve:
1. Size: NPS 2-1/2, NPS 3or NPS 4.
2. Compliance: MSS SP-67.
3. Full-port, epoxy-coated, ductile-iron lug body.
4. Seat: EPDM, minus 30 deg F to plus 250 deg F.
5. Face-to-Face Flange: ASME B16.5 flanges.
6. Disc Design: Floating stainless-steel dual shaft.
7. Disc Material: Iron nylon 11or Stainless steel.

8. Locating Pin: Carbon steel.
9. Bushings: PTFE.
10. O-Rings: EPDM.
11. Ten position stop.
12. Manual override control turn-knob for emergency operation of the valve.

E. Clothes Washer Shutoff Control Valve: Two-way, four-port, low-zinc bronze alloy valve.
1. End Connections: Male hose connections, NPS 3/4.
2. Pressure Rating: 400 psi at 32 to 150 deg F.
3. Maximum Test Pressure: 1200 psig.
4. Stem Travel: 0.16 inch.
5. Maximum Temperature: 250 deg F.
6. Valve Stem: Burnished Type 303 stainless steel.
7. Valve Stem Packing: Double EPDM.
8. Valve Seat: Integral bronze.
9. Valve Disc and Plunger: EPDM.
10. Valve Spring: Stainless steel.
11. Hoses: Two, 9-inch steel braided.
12. Hose End Connections: One straight and one 90-degree elbow connection; both hoses.

F. Clothes Washer Shutoff Control Valve Actuator: Two position, drive closed, spring open.
1. Housing: High-temperature composite glass-filled nylon.
2. Connection to Valve: NPT female brass ring.
3. Electric Motor: Reversible, brushless, and synchronism, maintains constant control speed to keep the cycle time constant. Maximum stem output is force balance controlled with electronic shutoff when end travel is detected in both directions.
4. Maximum Working Force: 48 lbf.
5. Power Requirements:
    a. Input Voltage: 24 V ac.
    b. Frequency: 60or 50 Hz.
    c. Current: 0.045 A.
    d. Power: 1 VA.
6. Power Supply: 120-V ac to 24-V ac transformer with cord and plug.
7. Working Time: 90 seconds.
8. Duty Rating: 100 percent.
9. Travel: 0.16 inch.
10. Position Indicator: Standard.
11. Working Temperature: 40 to 120 deg F.
12. Conform to CE and ROHS requirements.

G. Water Main Shutoff Valve Actuator: Motor operated, with or without gears, electric and electronic. Capable of closing valve against inlet pressure. Direct mount, two way; fails open/open or closed/closed.
1. Actuator Torque: 133or 266 in-lbf.
2. Power Requirements:
    a. Input Voltage: 12or 24 V dc.
    b. Frequency: 60or 50 Hz.
    c. Current: 2 A.
    d. Power: 15or 24 VA.
3. Power Supply: 120-V ac to 12or 24-V dc transformer with cord and plug.
4. Working Time: 8or 10 seconds.
5. Torque Limiter: STD.
6. Duty Rating: 50or 75 percent.
7. Protection: IP65or IP67.
8. Rotation: 90or 180 degrees.

9. Manual Intervention: Allowed.
10. Position Indicator: Standard.
11. Working Temperature: Minus 4 deg F to plus 131 deg F.

H. Domestic Water Heater Shutoff Valve Actuator: Motor operated, with or without gears, electric and electronic. Capable of closing valve against inlet pressure. Direct mount, two way; fails open/open or close/close.
1. Power Requirements:
a. Input Voltage: 24 V ac.
b. Frequency: 60or 50 Hz.
c. Current: 0.6 A.
d. Power: 15 VA.
2. Power Supply: 120-V ac to 24-V ac transformer with cord and plug.
3. Working Time: 45 seconds.
4. Rotation: 90 degrees.
5. Manual Intervention: Allowed.
6. Position Indicator: LED for closed position.
7. Working Temperature: 0 to 100 deg F.
8. Audible Alarm: 83 dB.

I. Actuator Enclosure: Suitable for ambient conditions encountered by application.
1. NEMA 250, Type 2 for indoor and protected applications.
2. Material: Self-extinguishing class techno-polymer.

J. Wireless Leak Detection Receiver System:
1. Onboard Battery Backup: 48 hours of protection. Valve to close prior to backup failure.
2. LED Indicators: Wireless signal strength, communication loss, water fault, low temperature fault, and low battery.
3. Output Contacts: Interface with home security or building automation system, cellular text notification service, or auto dialer accessories.
4. FCC Approved Wireless Communication System: Between devices; sensors, repeaters, and receivers:
a. Proprietary 900-MHz wireless communication platform ensures system operation without Wi-Fi dependence or other communication platforms, subject to power and random service outages.
b. Automatic wireless communication testing and positive confirmation ensure system devices remain active and working correctly. Automatic fault notification for lost communication or missing device.
5. Power Supply: 120 V acor 9-V dc battery.
6. Dual Function Wireless Sensors: 2. Valve closes if temperature falls below 45 deg F.
a. Wireless Signal Range: 100 feet between sensors and receiver.
b. Custom range finding feature.
c. LED Indicators: Wireless signal strength, communication loss, water fault, low temperature, and low battery.
7. Self-monitoring enabled system; faults for lost communication between receiver and sensor(s).
8. Closed-Loop RF System: System remains active even when power and Wi-Fi signals are lost.

K. Wired Leak Detection System: Local water sensor.
1. Power Supply: Class II transformer with cord and plug, 120 V ac, UL listed.
a. Power Cord Length: 12 feet.
2. Control Panel: LED power and LED valves indicator.
3. Alarms: Audible alarm, with external output.
4. Wired Sensors:
a. Quantity Per Receiver: 1to 6.

b. Cable Length: 8, 25, 50or 100 feet.

5. Sensor Elevation: Elevated 1/2 inches above condensate drain pan.

L. Accessories:

1. Water Flow Sensors: Pipe-mounted to detect water flow.
2. Rope Sensor: Absorbent water sensing rope constructed from twisted metal conductor wires insulated from one another and surrounded by polyethylene mesh braid jacket. Connect up to 100 feet (10 sections) of sensor rope to a single receiver.
3. Electrical Plug Interrupter: Plugs into standard 120-V ac wall outlet.
4. Gas Flow Interrupter: ECO Connector with female spade connectors. Factory prewired, 8 feet.
5. Gas Interface Cable: Interface cable with male and female connectors.
6. Step-Down Transformer: 120, 208or 240 V ac to 24 V ac with mounting plate, 12-foot plenum wire to power, and 8-foot plenum wire to sensor.
7. Liquid Level Sensors: Monitor fluid levels in addition to detecting plumbing leaks.
8. Auto Dialer: Send and receive automatic alerts when a fault condition occurs. Standard output contacts trigger up to nine predetermined telephone number calls.
   a. Prerecord message for future playback.
   b. 10-second recordable message.
   c. Built-in tamper switch.
   d. DC adaptor with battery backup.
   e. Programmable as a silent (dialer only) or audible (siren and dialer) alarm.
   f. Easy "Stop Call Sequence" - push "#" on phone to acknowledge the alarm and stop the dialing sequence.
9. Cellular Text Notification System.
   a. Event SMS text notification to up to three cell phones.
   b. Battery backup, four (4) AA batteries.
   c. 12-foot interface cable to leak detection system.
   d. Customized messaging.
   e. Wireless network service provider.
10. Cable Adder: 10, 25, 50or 100 feet in length.
11. Wireless Signal Repeater: Boosts signal performance between wireless sensors and receiver.
    a. Push-button pairing and unpairing, into and out of the network.
    b. Visual indication of wireless signal strength, low battery, and lost communication.
    c. Standard wall outlet, 120 V ac, power.
    d. Battery backup: Two (2) AA batteries for battery backup to maintain system integrity during a power outage.
12. Wireless Water Switch: Allows manual override or wireless system functionality and closes the valve to shut off water flow.
13. Hard-Wired Water Switch: Allows manual override or wireless system functionality and closes the valve to shut off water flow.

2.07 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Armstrong International, Inc.
   b. ITT Corporation.
   c. NIBCO INC.
   d. TACO Comfort Solutions, Inc.
   e. WATTS.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
3. Body: Brass or bronze.

4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Armstrong International, Inc.
   b. ITT Corporation.
   c. NIBCO INC.
   d. WATTS.
2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Memory-Stop Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
   d. Red-White Valve Corp.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.08 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Leonard Valve Company.
   c. POWERS; A WATTS Brand.
   d. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: Refer to Plumbing design drawings.
9. Tempered-Water Design Flow Rate: Refer to Plumbing design drawings.
10. Valve Finish: Chrome platedor Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Lawler Manufacturing Company, Inc.
      b. Leonard Valve Company.
      c. POWERS; A WATTS Brand.
      d. Symmons Industries, Inc.
   2. Standard: ASSE 1017.
   3. Pressure Rating: 125 psig minimum unless otherwise indicated.
   4. Type: Exposed-mounted or Cabinet-type, thermostatically controlled, water mixing valve.
   5. Material: Bronze body with corrosion-resistant interior components.
   6. Connections: Threaded union inlets and outlet.
   7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
   8. Tempered-Water Setting: Refer to Plumbing design drawings.
   9. Tempered-Water Design Flow Rate: Refer to Plumbing design drawings.
   10. Selected Valve Flow Rate at 45-psig Pressure Drop: Refer to Plumbing design drawings.
   11. Pressure Drop at Design Flow Rate: Refer to Plumbing design drawings.
   12. Valve Finish: Polished, chrome plated or Rough bronze.
   13. Piping Finish: Chrome plated or Copper.
   14. Cabinet: Factory fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.

C. Individual-Fixture, Water Tempering Valves:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Lawler Manufacturing Company, Inc.
      c. Leonard Valve Company.
      d. POWERS; A WATTS Brand.
      e. WATTS.
   2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
   3. Pressure Rating: 125 psig minimum unless otherwise indicated.
   4. Body: Bronze body with corrosion-resistant interior components.
   5. Temperature Control: Adjustable.
   6. Inlets and Outlet: Threaded.
   7. Finish: Rough or chrome-plated bronze.
   8. Tempered-Water Setting: Refer to Plumbing design drawings.
   9. Tempered-Water Design Flow Rate: Refer to Plumbing design drawings.

D. Primary Water Tempering Valves:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Heat-Timer Corporation.
      b. Holby Valve Inc.
      c. Uponor.
   2. Standard: ASSE 1017, thermostatically controlled, water tempering valve, listed as tempering valve.
   3. Pressure Rating: 125 psig minimum unless otherwise indicated.
   4. Body: Bronze.
   5. Temperature Control: Manual.

6. Inlets and Outlet: Threaded.
7. Selected Primary Water Tempering Valve Size: Refer to Plumbing design drawings.
8. Tempered-Water Setting: Refer to Plumbing design drawings.
9. Tempered-Water Design Flow Rate: Refer to Plumbing design drawings.
10. Pressure Drop at Design Flow Rate: Refer to Plumbing design drawings.
11. Tempered-Water Outlet Size: Refer to Plumbing design drawings.
12. Cold-Water Inlet Size: Refer to Plumbing design drawings.
13. Hot-Water Inlet Size: Refer to Plumbing design drawings.
14. Valve Finish: Rough bronze.

2.09 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
   1. Pressure Rating: 125 psig minimum unless otherwise indicated.
   2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
   3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
   4. Screen: Stainless steel with round perforations unless otherwise indicated.
   5. Perforation Size:
      a. Strainers NPS 2 and Smaller: 0.020, 0.033or 0.062 inch.
      b. Strainers NPS 2-1/2 to NPS 4: 0.045, 0.062or 0.125 inch.
      c. Strainers NPS 5 and Larger: 0.10, 0.125or 0.25 inch.
   6. Drain: Pipe plugand Factory-installed, hose-end drain valve.

2.10 OUTLET BOXES

A. Clothes Washer Outlet Boxes:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Guy Gray Manufacturing Co., Inc.
      b. IPS Corporation.
      c. LSP Products Group, Inc.
      d. Oatey.
   2. Mounting: Recessed.
   3. Material and Finish: Enameled-steel, epoxy-painted-steelor Stainless-steel box and faceplate.
   4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
   5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
   6. Drain: NPS 1-1/2or NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
   7. Inlet Hoses: Two 60-inch-long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
   8. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. IPS Corporation.
      b. LSP Products Group, Inc.
      c. Oatey.
      d. Plastic Oddities.

2. Mounting: Recessed.
3. Material and Finish: Enameled-steel, epoxy-painted-steel Stainless-steel box and face-plate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.11 HOSE BIBBS

A. Hose Bibbs:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Jay R. Smith Mfg. Co.
   b. MIFAB, Inc.
   c. WATTS.
   d. Woodford Manufacturing Company.
   e. Acorn Manufacturing.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Rough bronze, Chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Wheel handleor Operating key.
14. Operation for Finished Rooms: Wheel handleor Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.12 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:
   1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
   2. Pressure Rating: 200-psig minimum CWP or Class 125.
   3. Size: NPS 3/4.
   4. Body: Copper alloy or ASTM B62 bronze.
   5. Drain: NPS 1/8 side outlet with cap.

2.13 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. MIFAB, Inc.
      b. Precision Plumbing Products.
      c. Sioux Chief Manufacturing Company, Inc.
      d. WATTS.
   2. Standard: ASSE 1010 or PDI-WH 201.
   3. Type: Metal bellows.
   4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.14 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Jay R. Smith Mfg. Co.
      b. MIFAB, Inc.
      c. Precision Plumbing Products.
   2. Standard: ASSE 1018.
   3. Pressure Rating: 125 psig minimum.
   4. Body: Bronze.
   5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
   6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
   7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Jay R. Smith Mfg. Co.
   2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
   3. Size: NPS 1-1/4 minimum.
   4. Material: Chrome-plated, cast brass.

2.15 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Precision Plumbing Products.
      b. Zurn Industries, LLC.
   2. Standard: ASSE 1044.
   3. Piping: NPS 3/4, ASTM B88, Type L; copper, water tubing.
   4. Cabinet: Recessedor Surface-mounted steel box with stainless-steel cover.

5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
   a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: Refer to Plumbing design drawings.
8. Size Outlets: NPS 1/2or NPS 5/8.

2.16 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Flex-Hose Co., Inc.
   2. Flex-Weld, Inc.
   3. Metraflex Company (The).

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
   1. Working-Pressure Rating: Minimum 200 psigor 250 psig.
   2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
   3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
   1. Working-Pressure Rating: Minimum 200 psigor 250 psig.
   2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
   3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.17 WATER METERS

A. Displacement-Type Water Meters:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. AALIANT.
      b. ABB.
      c. Mueller Co.
      d. Sensus.
   2. Standard: AWWA C700.
   3. Pressure Rating: 150-psig working pressure.
   4. Body Design: Nutating disc; totalization meter.
   5. Registration: In gallons or cubic feet as required by utility company.
   6. Case: Bronze.
   7. End Connections: Threaded.

B. Turbine-Type Water Meters:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Badger Industries, Inc.
      b. Master Meter, Inc.
      c. Sensus.
   2. Standard: AWWA C701.
   3. Pressure Rating: 150 psig working pressure.
   4. Body Design: Turbine; totalization meter.
   5. Registration: In gallons or cubic feet as required by utility company.
   6. Case: Bronze.
   7. End Connections for Meters NPS 2 and Smaller: Threaded.

8. End Connections for Meters NPS 2-1/2 and Larger: Flanged.

C. Compound-Type Water Meters:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Badger Industries, Inc.
      b. Mueller Co.
      c. Sensus.
   2. Standard: AWWA C702.
   3. Pressure Rating: 150-psig working pressure.
   4. Body Design: With integral mainline and bypass meters; totalization meter.
   5. Registration: In gallons or cubic feet as required by utility company.
   6. Case: Bronze.
   7. Pipe Connections: Flanged.

D. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 EXECUTION

3.01 INSTALLATION

A. Backflow Preventers: Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or system.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
   3. Do not install bypass piping around backflow preventers.

B. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Water Control Valves: Install with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

D. Automatic Water Shutoff Valves: Test for signal strength before valve installation. Install automatic shutoff valve downstream from main domestic water shutoff valve and downstream from fire sprinkler system supply. Install valve controller is an accessible location with sensors in areas where water is likely to accumulate.

E. Balancing Valves: Install in locations where they can easily be adjusted.

F. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified.

G. Y-Pattern Strainers: For water, install on supply side of each control valve, water pressure-reducing valve, solenoid valve and/or pump.

H. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 06 10 00 "Rough Carpentry."

I. Water-Hammer Arresters: Install in water piping according to PDI-WH 201.

J. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

K. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

L. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.02 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

C. Comply with requirements for grounding equipment in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.03 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Pressure vacuum breakers.
   2. Intermediate atmospheric-vent backflow preventers.
   3. Reduced-pressure-principle backflow preventers.
   4. Double-check, backflow-prevention assemblies.
   5. Carbonated-beverage-machine backflow preventers.
   6. Dual-check-valve backflow preventers.
   7. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
   8. Double-check, detector-assembly backflow preventers.
   9. Water pressure-reducing valves.
   10. Automatic water shutoff valves.
   11. Calibrated balancing valves.
   12. Primary, thermostatic, water mixing valves.
   13. Manifold, thermostatic, water mixing-valve assemblies.
   14. Photographic-process, thermostatic, water mixing-valve assemblies.
   15. Primary water tempering valves.
   16. Outlet boxes.
   17. Supply-type, trap-seal primer valves.
   18. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly and/or double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.05 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 22 11 19

SECTION 22 11 23.21
INLINE, DOMESTIC-WATER PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. In-line, sealless centrifugal pumps.

B. Horizontally mounted, in-line, separately coupled centrifugal pumps.

C. Horizontally mounted, in-line, close-coupled centrifugal pumps.

D. Vertically mounted, in-line, close-coupled centrifugal pumps.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Detail pumps and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Structural members to which pumps will be attached.
   2. Size and location of initial access modules for acoustical tile.

B. Seismic Qualification Data: Certificates, for inline, domestic-water pumps, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For inline, domestic-water pumps to include in operation and maintenance manuals.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written instructions for handling.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: UL 778 for motor-operated water pumps.

C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

D. Retain "Seismic Performance" Paragraph below with "Seismic Qualification Data" Paragraph in "Informational Submittals" Article for projects requiring seismic design. Delete paragraph if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with structural engineer.

E. Seismic Performance: Inline, domestic-water pumps shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Component Importance Factor: 1.0.

2.02 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Grundfos Pumps Corp.
   2. WILO USA LLC - WILO Canada Inc.
   3. Bell & Gossett

C. Capacities and Characteristics: Refer to Drawings.

D. Pump Construction:
   1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
   2. Minimum Working Pressure: 175 psi.
   3. Maximum Continuous Operating Temperature: 220 deg F.
   4. Casing: Cast iron, with threaded or companion-flange connections.
   5. Impeller: stainless steel.
   6. Motor: ECM variable speed motor

2.03 CONTROLS

A. Provie integral controls with pumps that are capable of:
   1. Proportional Pressure – The differential pressure will continuously increase or decrease along a linear curve based on the flow demand.
   2. Constant Pressure – The pump maintains a constant differential pressure set by the user at any flow demand until the maximum speed is reached.
   3. Constant Speed – The pump maintains a constant speed at any flow rate
   4. Night Set Back – The pump will recognize a 10°C water temperature reduction and will switch to nighttime operation.
   5. T-Constant – This control will use a PI algorithm to vary the speed of the pump in order to maintain a constant temperature of the fluid media.
   6. Delta-T Constant – This control mode will use a PI algorithm to vary the speed of the pump in order to maintain a constant differential temperature between the built-in temperature sensor and external temperature sensor.

7. Delta-P-T – This control mode is paired with proportional or constant pressure mode. The nominal differential pressure setpoint will vary according to the fluid temperature.
8. Delta-P-Delta-T – This control mode is paired with proportional or constant pressure mode. The nominal differential pressure setpoint will vary according to the differential temperature between the built-in temperature sensor and external temperature sensor.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

3.02 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Mount pumps in orientation complying with manufacturer's written instructions.

C. Pump Mounting:
   1. Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using vibration isolation type and deflection as specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.
   1. Comply with requirements for vibration isolation devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
   2. Comply with requirements for hangers and supports specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

E. Install pressure switches in water-supply piping.

F. Install thermostats in hot-water return piping.

G. Install timers in heater room location.

H. Install time-delay relays in piping between water heaters and hot-water storage tanks.

3.03 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.

C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
   1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
      a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
      b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
      c. Vertically mounted, in-line, close-coupled centrifugal pumps.

d. Comply with requirements for flexible connectors specified in Section 22 11 16 "Domestic Water Piping."

D. Provide shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves and unions same size as connected piping. Comply with requirements for strainers specified in Section 22 11 19 "Domestic Water Piping Specialties." Comply with requirements for valves specified in the following:
1. Section 22 05 23 "General Duty Valves for Plumbing."
2. Provide pressure gauge at suction of each pump and pressure gauge at discharge of each pump. Install at integral pressure-gauge tappings where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

3.04 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between temperature controllers and devices.

C. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.05 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Contracting Agency will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.07 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup check according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set pressure switches, thermostats, timers, and time-delay relays for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:
a. Verify bearing lubrication.

b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.08 ADJUSTING

A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 22 11 23.21

This page intentionally left blank

SECTION 22 13 16
SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hubless, cast-iron soil pipe and fittings.

B. Copper tube and fittings.

C. ABS pipe and fittings.

D. PVC pipe and fittings.

E. Specialty pipe fittings.

F. Encasement for underground metal piping.

1.02 RELATED DOCUMENTS

A. Section 22 00 00 “General Plumbing Requirements.”

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.

C. Sustainable Design Submittals:
   1. Product Data: For adhesives, indicating VOC content.
   2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

D. Shop Drawings: For hubless, single-stack drainage system include plans, elevations, sections, and details.

1.04 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
   2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.05 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Contracting Agency or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Architect, Construction Manager and Contracting Agency no fewer than two days in advance of proposed interruption of sanitary waste service.
   2. Do not proceed with interruption of sanitary waste service without Architect's, Construction Manager's and Contracting Agency's written permission.

1.06 WARRANTY

A. Listed manufacturers to provide labelling and warranty of their respective products.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
   1. Soil, Waste, and Vent Piping: 10-foot head of water.
   2. Waste, Force-Main Piping: 50 psig, 100 psig or 150 psig.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.02 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.03 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. AB & I Foundry; a part of the McWane family of companies.
   2. Charlotte Pipe and Foundry Company.
   3. Tyler Pipe; a part of McWane family of companies.

B. Pipe and Fittings: ASTM A888 or CISPI 301.

C. CISPI, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. ANACO-Husky.
      b. Charlotte Pipe and Foundry Company.
      c. Tyler Pipe; a subsidiary of McWane Inc.
   2. Standards: ASTM C1277 and CISPI 310.
   3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

D. Heavy-Duty, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. ANACO-Husky.
      b. Charlotte Pipe and Foundry Company.
      c. Tyler Pipe; a subsidiary of McWane Inc.
   2. Standards: ASTM C1277 and ASTM C1540.
   3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.04 COPPER TUBE AND FITTINGS

A. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B88, Type L and Type M, water tube, drawn temper.

D. Copper Pressure Fittings:
   1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
   2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

E. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
   1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

F. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

2.05 ABS PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall ABS Pipe: ASTM D2661, Schedule 40.

C. Cellular-Core ABS Pipe: ASTM F628, Schedule 40.

D. ABS Socket Fittings: ASTM D2661, made to ASTM D3311, drain, waste, and vent patterns.

E. Solvent Cement: ASTM D2235.
   1. Solvent cement shall have a VOC content of 325 g/L or less.
   2. Solvent cement shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.06 PVC PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D2665, drain, waste, and vent.

C. Cellular-Core PVC Pipe: ASTM F891, Schedule 40.

D. PVC Socket Fittings: ASTM D2665, made to ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

E. Adhesive Primer: ASTM F656.
   1. Adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Solvent Cement: ASTM D2564.
   1. Solvent cement shall have a VOC content of 510 g/L or less.

2.07 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
   1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
   2. Shielded, Nonpressure Transition Couplings:
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
         1) Cascade Waterworks Mfg. Co.
         2) Mission Rubber Company, LLC; a division of MCP Industries.
      b. Standard: ASTM C1460.
      c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
      d. End Connections: Same size as and compatible with pipes to be joined.

2.08 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A674 or AWWA C105/A 21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inchminimum thickness.

C. Form: Sheet or tube.

D. Color: Natural.

PART 3 EXECUTION

3.01 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earthwork.

3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
   1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
   2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Provided seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. All cleanouts shall be installed where readily accessible. The contractor shall coordinate all cleanout locations with equipment, cabinets, etc. and architect prior to any installation.

L. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
   1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
   2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
      a. Straight tees, elbows, and crosses may be used on vent lines.
   3. Do not change direction of flow more than 90 degrees.
   4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
      a. Reducing size of waste piping in direction of flow is prohibited.

M. Lay buried building waste piping beginning at low point of each system.
   1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
   2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
   3. Maintain swab in piping and pull past each joint as completed.

N. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
   1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 or 2percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
   3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

O. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Install encasement on underground piping according to ASTM A674 or AWWA C105/A 21.5.

P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

Q. Install aboveground ABS piping according to ASTM D2661.

R. Install aboveground PVC piping according to ASTM D2665.

S. Install underground ABS and PVC piping according to ASTM D2321.

T. Install engineered soil and waste and vent piping systems as follows:
   1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
   2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.
   3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

U. Install underground, ductile-iron, force-main piping according to AWWA C600.
   1. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints.
   2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
   3. Install encasement on piping according to ASTM A674 or AWWA C105/A 21.5.

V. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
   1. Install encasement on piping according to ASTM A674 or AWWA C105/A 21.5.

W. Install force mains at elevations indicated.

X. Plumbing Specialties:
   1. Install backwater valves in sanitary waster gravity-flow piping.
      a. Comply with requirements for backwater valves specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
   2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
      a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
      b. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
   3. Install drains in sanitary waste gravity-flow piping.
      a. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

Y. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Z. Install sleeves for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

AA. Install sleeve seals for piping penetrations of concrete walls and slabs.
   1. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

BB. Install escutcheons for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
1. Cut threads full and clean using sharp dies.
2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
c. Do not use pipe sections that have cracked or open welds.

E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

F. Join copper tube and fittings with soldered joints according to ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.

G. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

I. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D2235 and ASTM D2661 appendixes.
3. PVC Piping: Join according to ASTM D2855 and ASTM D2665 appendixes.

3.04 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Unshielded or Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:
a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:
1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits or nipples.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.05 VALVE INSTALLATION

A. Comply with requirements in Section 22 05 23 :"General Duty Valves for Plumbing" for general-duty valve installation requirements.

B. Shutoff Valves:
   1. Install shutoff valve on each sewage pump discharge.
   2. Install full-port ball valve for piping NPS 2 and smaller.
   3. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.
   1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
   2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
   3. Install backwater valves in accessible locations.
   4. Comply with requirements for backwater valve specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

3.06 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment." and Section 22 05 48 "Vibration Controls for Plumbing Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install stainless-steel or fiberglass pipe hangers for horizontal piping in corrosive environments.
   3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
   5. Vertical Piping: MSS Type 8 or Type 42, clamps.
   6. Install individual, straight, horizontal piping runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
   7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
   6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 2: 84 inches with 3/8-inch rod.
   2. NPS 3: 96 inches with 1/2-inch rod.
   3. NPS 4: 108 inches with 1/2-inch rod.
   4. NPS 6: 10 feet with 5/8-inch rod.

J. Install supports for vertical stainless-steel piping every 10 feet.

K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 72 inches with 3/8-inch rod.
   2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   3. NPS 2-1/2: 108 inches with 1/2-inch rod.
   4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
   5. NPS 6: 10 feet with 5/8-inch rod.
   6. NPS 8: 10 feet with 3/4-inch rod.

L. Install supports for vertical copper tubing every 10 feet.

M. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
   2. NPS 3: 48 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

N. Install supports for vertical ABS and PVC piping every 48 inches.

O. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.07 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:
   1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
   5. Install horizontal backwater valves with cleanout cover flush with floor or in pit with pit cover flush with floor.
   6. Comply with requirements for backwater valves cleanouts and drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
   7. Equipment: Connect waste piping as indicated.
      a. Provide shutoff valve if indicated and union for each connection.
      b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:
   1. Sanitary Sewer: To exterior force main.
   2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections according to the following unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.08 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.09 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
      a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
      a. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
      a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
      b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
      c. Inspect joints for leaks.
   4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
      a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
      b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
      c. Air pressure must remain constant without introducing additional air throughout period of inspection.
      d. Inspect plumbing fixture connections for gas and water leaks.
   5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
      a. Expose work that was covered or concealed before it was tested.
   2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
      a. Isolate test source and allow to stand for four hours.
      b. Leaks and loss in test pressure constitute defects that must be repaired.
   3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Cover all floor drains and floor sinks during constructions to prevent debris from entering pipe and protect grates from damages.

D. Place plugs in ends of uncompleted piping at end of day and when work stops.

E. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

F. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
   3. Galvanized-steel pipe, drainage fittings, and threaded joints.
   4. Copper Type DWV tube, copper drainage fittings, and soldered joints.
   5. Solid-wall or Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.
   6. Solid-wall or Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
   7. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.

C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
   3. Galvanized-steel pipe, drainage fittings, and threaded joints.
   4. Solid-wall or Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
   5. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.

D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
   3. Galvanized-steel pipe, drainage fittings, and threaded joints.
   4. Copper Type DWV tube, copper drainage fittings, and soldered joints.
      a. Option for Vent Piping, NPS 2-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.

5. Solid-wall or Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.
6. Solid-wall or Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
7. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.

E. Aboveground, vent piping NPS 5 and larger shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
3. Galvanized-steel pipe, drainage fittings, and threaded joints.
4. Solid-wall or Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.

F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
1. Extra Heavy or Service class, cast-iron soil piping; gaskets; and gasketed or calking materials; and calked joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty cast-iron hubless-piping couplings; and coupled joints.
3. Solid wall or Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.
4. Solid wall or Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.

G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Extra Heavy or Service class, cast-iron soil piping; gaskets; and gasketed or calking materials; and calked joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty cast-iron hubless-piping couplings; coupled joints.
3. Solid-wall or Cellular-core PVC pipe; PVC socket fittings; and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.

H. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be any of the following:
1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
2. Galvanized-steel pipe, pressure fittings, and threaded joints.

I. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6shall be any of the following:
1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
2. Galvanized-steel pipe, pressure fittings, and threaded joints.
3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

J. Underground sanitary-sewage force mains NPS 4 and smaller shall be any of the following:
1. Hard copper tube, Type L; wrought-copper pressure fittings; and soldered joints.
2. Ductile-iron, mechanical-joint piping and mechanical joints.
3. Ductile-iron, push-on-joint piping and push-on joints.
4. Ductile-iron, grooved-joint piping and grooved joints.
5. Fitting-type transition coupling for piping smaller than NPS 1-1/2 and pressure transition coupling for NPS 1-1/2 and larger if dissimilar pipe materials.

K. Underground sanitary-sewage force mains NPS 5 and larger shall be any of the following:
1. Hard copper tube, Type L; wrought-copper pressure fittings; and soldered joints.
2. Ductile-iron, mechanical-joint piping and mechanical joints.
3. Ductile-iron, push-on-joint piping and push-on joints.
4. Ductile-iron, grooved-joint piping and grooved joints.
5. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION 22 13 16

This page intentionally left blank

SECTION 22 13 19
SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Backwater valves.

B. Cleanouts.

C. Roof flashing assemblies.

D. Through-penetration firestop assemblies.

E. Miscellaneous sanitary drainage piping specialties.

F. Floor drains.

G. Floor sinks.

H. Trench drains.

1.02 RELATED REQUIREMENTS

A. Section 22 14 23 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.03 RELATED DOCUMENTS

A. Section 22 00 00 “General Plumbing Requirements.”

1.04 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene.

B. FOG: Fats, oils, and greases.

C. PVC: Polyvinyl chloride.

D. FRP: Fiberglass-reinforced plastic.

E. HDPE: High-density polyethylene.

F. PE: Polyethylene.

G. PP: Polypropylene.

1.05 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product. Include rated capacities, operating characteristics, and accessories for the following:
   1. FOG disposal systems.

C. Shop Drawings:
   1. Show fabrication and installation details for frost-resistant vent terminals.
   2. Wiring Diagrams: Power, signal, and control wiring.

1.06 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: For FOG disposal systems, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 PRODUCTS

2.01 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

2.02 CLEANOUTS

A. Cast-Iron Exposed Cleanouts: :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Jay R. Smith Mfg. Co.
   b. MIFAB, Inc.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Stainless-Steel Exposed Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. BL CHER; A Watts brand.
   b. Josam Company.
   c. Watts.
2. Standard: ASME A112.3.1.
3. Size: Same as connected drainage piping
4. Body Material: Stainless-steel tee with side cleanout as required to match connected piping.
5. Closure: Stainless-steel plug with seal.

C. Cast-Iron Exposed Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Jay R. Smith Mfg. Co.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing or threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing or threaded, adjustable housing.
5. Body or Ferrule: Cast iron.

6. Clamping Device: As Required.
7. Outlet Connection: Inside calk, Spigot, or Threaded.
8. Closure: Brass plug with straight threads and gasket or Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads or setscrews.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy Polished bronze, or Rough bronze.
11. Frame and Cover Shape: Round, or Square when specifically requested by Contracting Agency.
12. Top Loading Classification: Heavy duty at exterior locations. Light or Medium Duty within building.
13. Riser: ASTM A74, Extra-Heavy or Service class, cast-iron drainage pipe fitting and riser to cleanout.

D. Stainless-Steel Exposed Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. BL CHER; a Watts brand.
   b. Josam Company.
   c. Kusel Equipment Co.
2. Standard: ASME A112.3.1.
3. Size: Same as connected branch.
4. Housing: Stainless steel.
5. Closure: Stainless steel with seal.
6. Riser: ASTM A74, Extra-Heavy or Service class, stainless-steel drainage pipe fitting and riser to cleanout.
7. Body or Ferrule: Stainless steel.
8. Clamping Device: as Required.
9. Outlet Connection: Inside calk, Spigot, or Threaded.
10. Closure: Brass plug with straight threads and gasket, or Brass plug with tapered threads.
11. Adjustable Housing Material: Cast iron with threads or setscrews.
12. Frame and Cover Material and Finish: Nickel-bronze, copper alloy, or Stainless steel.
13. Frame and Cover Shape: Round or Square when specifically requested by Contracting Agency.
14. Top Loading Classification: Heavy duty at exterior locations. Light or Medium Duty within building.

E. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Jay R. Smith Mfg. Co.
   b. MIFAB, Inc.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch, or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
   a. Brass Cast iron.
   b. Countersunk or raised head.
   c. Drilled and threaded for cover attachment screw.
   d. Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.03 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Acorn Engineering Company.
      b. Thaler Metal Industries Ltd.
      c. Zurn Industries, LLC.
   2. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
      a. Open-Top Vent Cap: Without cap.
      b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
      c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.04 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. ProVent Systems.
   2. Standard: UL 1479 assembly of sleeve-and-stack fitting with firestopping plug.
   3. Size: Same as connected soil, waste, or vent stack.
   4. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
   5. Stack Fitting: ASTM A48/A48M, gray-iron, hubless-pattern wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
   6. Special Coating: Corrosion resistant on interior of fittings.

2.05 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:
   1. Description: Shop or field fabricate from ASTM A74, Service class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
   2. Size: Same as connected waste piping.

B. Deep-Seal Traps:
   1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
   2. Size: Same as connected waste piping.
      a. NPS 2: 4-inch-minimum water seal.
      b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:
   1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
   2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. Air-Gap Fittings:
   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.
   5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:
   1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch to 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
   2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings:
   1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
   2. Size: Same as connected stack vent or vent stack.

G. Vent Caps:
   1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
   2. Size: Same as connected stack vent or vent stack.

H. Frost-Resistant Vent Terminals:
   1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
   2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

I. Expansion Joints:
   1. Standard: ASME A112.6.4.
   2. Body: Cast iron with bronze sleeve, packing, and gland.
   3. End Connections: Matching connected piping.
   4. Size: Same as connected soil, waste, or vent piping.

2.06 FLOOR DRAINS

A. Cast-Iron Floor Drains:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Jay R. Smith Mfg. Co.
      b. MIFAB, Inc.
      c. WATTS.
   2. Standard: ASME A112.6.3 with backwater valve where required.
   3. Pattern: Area or Floor drain.
   4. Body Material: Gray iron.
   5. Seepage Flange: As Required.
   6. Anchor Flange: As Required.
   7. Clamping Device: As Required.
   8. Outlet: Bottom.
   9. Backwater Valve: Drain-outlet type or Integral, ASME A112.14.1, swing-check type.
   10. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
   11. Sediment Bucket: As Required.
   12. Top or Strainer Material: Nickel bronze or Stainless steel.
   13. Top of Body and Strainer Finish: Nickel bronze or Stainless steel.
   14. Top Shape: Round. Square when specifically requested by Contracting Agency.
   15. Dimensions of Top or Strainer: Refer to Plumbing Fixture Schedule on Construction Plans for body, sump, and grate requirements.
   16. Top Loading Classification: Heavy duty at exterior locations. Light or Medium Duty within building.
   17. Funnel: Not required.

18. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
19. Trap Material: Bronze, Cast iron or Copper.
20. Trap Pattern: Deep-seal P-trap or Standard P-trap.
21. Trap Features: Trap-seal primer valve drain connection.

B. Stainless-Steel Floor Drains, ASME A112.3.1:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Zurn Industries, LLC.
2. Outlet: Bottom or Side.
3. Top or Strainer Material: Stainless steel.
4. Top Shape: Round. Square when specifically requested by Contracting Agency.
5. Dimensions of Top or Strainer: Refer to Plumbing Fixture Schedule on Construction Plans for body, sump, and grate requirements.
6. Seepage Flange: As Required.
7. Anchor Flange: As Required.
8. Clamping Device: As Required.
9. Trap-Primer Connection: Required.
10. Trap Material: Stainless steel.
11. Trap Pattern: Deep-seal P-trap or Standard P-trap.

2.07 FLOOR SINKS

A. Cast-Iron Floor Sinks:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Jay R. Smith Mfg. Co.
   b. MIFAB, Inc.
   c. Watts; a Watts Water Technologies company.
   d. Zurn.
2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Cast iron.
5. Anchor Flange: As Required, with seepage holes.
6. Clamping Device: As Required.
7. Outlet: Bottom, no-hub connection.
8. Coating on Interior Surfaces: Acid-resistant enamel.
9. Sediment Bucket: Not required.
10. Internal Strainer: Dome or Flat.
11. Internal Strainer Material: Aluminum.
12. Top Grate Material: Cast iron, loose.
13. Top of Body and Grate Finish: Nickel bronze, Acid-resistant enamel.
14. Top Shape: Square.
15. Dimensions of Top Grate: Refer to Plumbing Fixture Schedule on Construction plans.
16. Top Loading Classification: No traffic.
17. Funnel: Not required.

2.08 TRENCH DRAINS

A. Trench Drains:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Jay R. Smith Mfg. Co.
b. MIFAB, Inc.
c. WATTS.
d. Zurn.
e. ACO.

2. Standard: ASME A112.6.3 for trench drains.
3. Material: Ductile or gray iron.
4. Flange: Anchor or Seepage, or As Required.
5. Clamping Device: As Required.
6. Outlet: Bottom, End or Side.
7. Grate Material: Ductile iron or Stainless steel.
8. Grate Finish: Painted or coated as required.
9. Dimensions of Frame and Grate: Refer to Plumbing Fixture Schedule on Construction plans for dimensions, body, sump, and grate requirements.
10. Top Loading Classification: Heavy duty at exterior locations. Light or Medium Duty within building.
11. Trap Material: Cast iron or Stainless steel.
12. Trap Pattern: Standard P-trap.

PART 3 EXECUTION

3.01 INSTALLATION

A. Equipment Mounting:
1. Comply with requirements for vibration-isolation and seismic-control devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
2. Comply with requirements for vibration-isolation devices specified in Section 22 05 48 "Vibration Controls for Plumbing Piping and Equipment."

B. Install cleanouts in building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 135 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.
5. At each horizontal drainage pipe upper terminal.
6. Above each Urinal.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

G. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
1. Comply with requirements in Section 07 84 00 "Firestopping."

H. Install deep-seal traps on floor drains and other waste outlets, if indicated.

I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
1. Exception: Fitting may be omitted if trap has trap-seal primer connection.

2. Size: Same as floor drain inlet.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

L. Install vent caps on each vent pipe passing through roof.

M. In freeze prone areas install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

O. In freeze prone areas install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

P. Install wood-blocking reinforcement for wall-mounting-type specialties.

Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

R. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
a. Maintain integrity of waterproof membranes where penetrated.
2. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

S. Install trench drains at low points of surface areas to be drained.
1. Set grates of drains flush with finished surface, unless otherwise indicated.

T. Comply with ASME A112.3.1 for installation of stainless-steel channel drainage systems.
1. Install on support devices, so that top will be flush with adjacent surface.

U. Install FRP channel drainage system components on support devices, so that top will be flush with adjacent surface.

V. Install plastic channel drainage system components on support devices, so that top will be flush with adjacent surface.

3.02 CONNECTIONS

A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

E. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

F. Comply with requirements in Section 22 13 19 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

G. Comply with requirements in Section 22 13 23 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.

3.03 FLASHING INSTALLATION

A. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.

C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

D. Set flashing on floors and roofs in solid coating of bituminous cement.

E. Secure flashing into sleeve and specialty clamping ring or device.

F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 07 62 00 "Sheet Metal Flashing and Trim."

G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.04 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the equipment.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
   1. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.05 FIELD QUALITY CONTROL

A. Perform tests and inspections, and prepare test reports.

B. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.06 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Contracting Agency's maintenance personnel to adjust, operate, and maintain FOG disposal systems. Refer to Section 01-06.5 “Owners Manuals / Operating Instructions.’

END OF SECTION 22 13 19

This page intentionally left blank

SECTION 22 13 23
SANITARY WASTE INTERCEPTORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grease interceptors.

B. Grease removal devices.

C. Oil interceptors.

D. Sand interceptors.

E. Solids interceptors.

1.02 RELATED DOCUMENTS

A. Section 22 00 00 “General Plumbing Requirements.”

1.03 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. PP: Polypropylene plastic.

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of metal and plastic interceptor. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.

C. Shop Drawings: For each type and size of precast concrete interceptor indicated.
   1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Piping connections. Include size, location, and elevation of each.
   2. Interface with underground structures and utility services.

1.06 FIELD CONDITIONS

A. Interruption of Existing Sewer Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services according to requirements indicated:
   1. Notify Architect Construction Manager Owner no fewer than seven days in advance of proposed interruption of service.
   2. Do not proceed with interruption of sewer services without Architect's Construction Manager's Owner's written permission.

PART 2 PRODUCTS

2.01 OIL INTERCEPTORS (OWS-1, OWS-2 AND OWS-3)

A. Precast Concrete Oil Interceptors: Comply with ASTM C913 Insert authorities having jurisdiction.
   1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
   2. Structural Design Loads:
      a. Light-Traffic Load: Comply with ASTM C890, A-8.
      b. Medium-Traffic Load: Comply with ASTM C890, A-12.
      c. Heavy-Traffic Load: Comply with ASTM C890, A-16.
      d. Walkway Load: Comply with ASTM C890, A-03.
   3. Resilient Pipe Connectors: ASTM C923, cast or fitted into interceptor walls, for each pipe connection.
   4. Steps: Individual FRP steps or FRP ladder Individual FRP steps, FRP ladder, or ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP Insert material, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 60 inches.
   5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
   6. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.
      a. Ductile Iron: ASTM A536, Grade 60-40-18, unless otherwise indicated.
      b. Gray Iron: ASTM A48/A48M, Class 35, unless otherwise indicated.
      c. Include indented top design with lettering cast into cover, using wording equivalent to "INTERCEPTOR OIL INTERCEPTOR SANITARY SEWER Insert lettering."

B. Capacities and Characteristics:
   1. Capacity: See Plans
   2. Inlet and Outlet Pipe Size: 4” and 6”
   3. End Connections: Hub.
   4. Waste-Oil-Outlet Pipe Size: See Plans
   5. Trapped Outlet Required: No.
   6. Cleanout: Integral.
   7. Vent Pipe Size: 2”
   8. Mounting: Recessed, flush with floor.
   9. Flow-Control Fitting: Not required.

2.02 PRECAST CONCRETE MANHOLE RISERS

A. Precast Concrete Manhole Risers: ASTM C478 ASTM C913, with rubber-gasket joints.
   1. Structural Design Loads:
      a. Light-Traffic Load: Comply with ASTM C890, A-8.
      b. Medium-Traffic Load: Comply with ASTM C890, A-12.
      c. Heavy-Traffic Load: Comply with ASTM C890, A-16.
      d. Walkway Load: Comply with ASTM C890, A-03.
   2. Length: From top of underground concrete structure to grade.
   3. Riser Sections: 3-inch minimum thickness and 36-inch diameter.
   4. Top Section: Eccentric cone, unless otherwise indicated. Include top of cone to match grade ring size.
   5. Gaskets: ASTM C443, rubber.
   6. Steps: Individual FRP steps or FRP ladder Individual FRP steps, FRP ladder, or ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101,

PP ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals.

B. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, diameter matching manhole frame and cover, and height as required to adjust the manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.
   1. Ductile Iron: ASTM A536, Grade 60-40-18, unless otherwise indicated.
   2. Gray Iron: ASTM A48/A48M, Class 35, unless otherwise indicated.
   3. Include indented top design with lettering cast into cover, using wording equivalent to the following:
      a. Grease Interceptors in Sanitary Sewerage System: "INTERCEPTOR GREASE INTERCEPTOR SANITARY SEWER Insert lettering."
      b. Oil Interceptors in Sanitary Sewerage System: "INTERCEPTOR OIL INTERCEPTOR SANITARY SEWER Insert lettering."

PART 3 EXECUTION

3.01 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 31 20 00 "Earthwork."

3.02 INSTALLATION

A. Equipment Mounting:
   1. Install grease interceptors grease removal devices and solids interceptors on cast-in-place concrete equipment base(s).
   2. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Install precast concrete interceptors according to ASTM C891.

C. Set interceptors level and plumb.

D. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.

E. Set tops of manhole frames and covers flush with finished surface in pavements.
   1. Set tops 3 inches above finish surface elsewhere unless otherwise indicated.

F. Set tops of grating frames and grates flush with finished surface.

G. Set metal and plastic interceptors level and plumb.

H. Set tops of metal interceptor covers flush with finished surface in pavements.
   1. Set tops 3 inches above finish surface elsewhere unless otherwise indicated.

I. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
   1. Above-Floor Installation: Set unit with bottom resting on floor unless otherwise indicated.
   2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
   3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
   4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

J. Install grease removal devices on floor. Install trap, vent, and flow-control fitting according to authorities having jurisdiction.
   1. Install control panel adjacent to unit unless otherwise indicated.

K. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

L. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet.
   1. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

3.03 CONNECTIONS

A. Piping installation requirements are specified in Section 22 13 16 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make piping connections between interceptors and piping systems.

3.04 IDENTIFICATION

A. Identification materials and installation are specified in Section 31 20 00 "Earthwork."
   1. Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
   2. Use warning tapes or detectable warning tape over ferrous piping.
   3. Use detectable warning tape over nonferrous piping and over edges of underground structures.

B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Oil interceptors.

3.05 PROTECTION

A. Protect sanitary waste interceptors from damage during construction period.

B. Repair damage to adjacent materials caused by sanitary waste interceptor installation.

END OF SECTION 22 13 23

SECTION 22 14 13
FACILITY STORM DRAINAGE PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. PVC pipe and fittings.

B. Specialty pipe and fittings.

1.02 RELATED DOCUMENTS

A. Section 22 00 00 “General Plumbing Requirements.”

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.

C. Sustainable Design Submittals:
   1. Product Data: For adhesives, indicating VOC content.
   2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

D. Shop Drawings: For controlled-flow siphonic roof drainage system. Include calculations, plans, and details.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Detail storm drainage piping. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Structural members to which drainage piping will be attached or suspended from.

B. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
   1. Storm Drainage Piping: 10-foot head of water.
   2. Storm Drainage, Force-Main Piping: 150 psig.

2.02 PVC PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Charlotte Pipe and Foundry Company.
   2. GF Piping Systems.
   3. JM Eagle.
   4. Mueller Industries, Inc.
   5. National Pipe and Plastic, Inc.
   6. North America Pipe Corporation.

7. Rocky Mountain Colby Pipe Company.
8. Silver-line Plastics.

B. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

C. Solid-Wall PVC Pipe: ASTM D2665; drain, waste, and vent.

D. Cellular-Core PVC Pipe: ASTM F891, Schedule 40.

E. PVC Socket Fittings: ASTM D2665, made to ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

F. Adhesive Primer: ASTM F656.

G. Solvent Cement: ASTM D2564.
1. Solvent cement shall have a VOC content of 510 g/L or less.

2.03 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Unshielded, Nonpressure Transition Couplings:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Dallas Specialty & Mfg. Co.
2) Fernco Inc.
3) Mission Rubber Company, LLC; a division of MCP Industries.
4) Plastic Oddities.
b. Standard: ASTM C1173.
c. Description: Elastomeric sleeve, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. Sleeve Materials:
1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
3) For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Cascade Waterworks Mfg. Co.
2) Mission Rubber Company, LLC; a division of MCP Industries.
b. Standard: ASTM C1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. End Connections: Same size as and compatible with pipes to be joined.
5. Pressure Transition Couplings:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Cascade Waterworks Mfg. Co.
2) EBAA Iron, Inc.
3) Ford Meter Box Company, Inc. (The).
4) JCM Industries, Inc.
5) Romac Industries, Inc.

b. Standard: AWWA C219.
c. Description: Metal, sleeve-type couplings same size as pipes to be joined, and with pressure rating at least equal to and ends compatible with pipes to be joined.
d. Center-Sleeve Material: Manufacturer's standard Carbon steel Stainless steel Ductile iron Malleable iron.
e. Gasket Material: Natural or synthetic rubber.
f. Metal Component Finish: Corrosion-resistant coating or material.

PART 3 EXECUTION

3.01 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Cover all roof and overflow drains during constructions to prevent debris from entering pipe and protect grates from damages.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

L. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
1. Do not change direction of flow more than 90 degrees.
2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
a. Reducing size of drainage piping in direction of flow is prohibited.

M. Lay buried building piping beginning at low point of each system.
1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

N. Install piping at the following minimum slopes unless otherwise indicated:
1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Storm Drainage Piping: 2 percent downward in direction of flow.

O. Install aboveground PVC piping according to ASTM D2665.

P. Install underground ABS and PVC piping according to ASTM D2321.

Q. Install engineered controlled-flow siphonic drain specialties and storm drainage piping in locations indicated.

R. Install underground, ductile-iron, force-main piping according to AWWA C600.
   1. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints.
   2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
   3. Install encasement on piping according to ASTM A674 or AWWA C105/A 21.5.

S. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
   1. Install encasement on piping according to ASTM A674 or AWWA C105/A 21.5.

T. Install force mains at elevations indicated.

U. Plumbing Specialties:
   1. Install backwater valves in storm drainage gravity-flow piping.
      a. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."
   2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.
      a. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
      b. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
   3. Install drains in storm drainage gravity-flow piping.
      a. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

V. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

W. Install sleeves for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install sleeve seals for piping penetrations of concrete walls and slabs.
   1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION

A. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. PVC Piping: Join according to ASTM D2855 and ASTM D2665 appendices.

B. Joint Restraints and Sway Bracing:
   1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
      a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
      b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.

c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.04 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in ODs.
   2. In Drainage Piping: Shielded, nonpressure transition couplings.
   3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
   4. In Underground Force-Main Piping:
      a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
      b. NPS 2 and Larger: Pressure transition couplings.

3.05 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install stainless-steel fiberglass pipe hangers for horizontal piping in corrosive environments.
   3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
   5. Vertical Piping: MSS Type 8 or Type 42, clamps.
   6. Install individual, straight, horizontal piping runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
   7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
   2. NPS 3: 48 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

G. Install supports for vertical ABS and PVC piping every 48 inches.

H. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.06 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.
   1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
   2. Install horizontal backwater valves in pit with pit cover flush with floor.

3. Comply with requirements for backwater valves cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance.

E. Make connections according to the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.07 IDENTIFICATION

A. Identify exposed storm drainage piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.08 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.
a. Expose work that was covered or concealed before it was tested.
3. Test Procedure:
a. Test storm drainage piping on completion of roughing-in.
b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

C. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
a. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
a. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

D. Piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.09 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:
   1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Aboveground, storm drainage piping NPS 8 and larger shall be any of the following:
   1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Underground storm drainage piping NPS 6 and smaller shall be any of the following:
   1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

E. Underground, storm drainage piping NPS 8 and larger shall be any of the following:
   1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
   2. Cellular-core, sewer and drain series, PVC pipe; PVC socket fittings; and solvent-cemented joints.

END OF SECTION 22 14 13

This page intentionally left blank

SECTION 22 14 23

STORM DRAINAGE PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal roof drains.

B. Miscellaneous storm drainage piping specialties.

C. Cleanouts.

1.02 RELATED REQUIREMENTS

A. Section 07 62 00 "Sheet Metal Flashing and Trim" for penetrations of roofs.

B. Section 07 84 00 " Firestopping" for firestopping roof penetrations.

1.03 RELATED DOCUMENTS

A. Section 22 00 00 “General Plumbing Requirements.”

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.

1.05 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 PRODUCTS

2.01 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Jay R. Smith Mfg. Co.
      b. MIFAB, Inc.
      c. Zurn Industries, LLC.
   2. Standard: ASME A112.6.4.
   3. Body Material: Cast iron.
   4. Dimension of Body: Nominal 14-to 16-inch diameter.
   5. Combination Flashing Ring and Gravel Stop: Required.
   6. Flow-Control Weirs: Required.
   7. Outlet: Bottom or Side.
   8. Outlet Type: No hubor Threaded.
   9. Extension Collars: Required.
   10. Underdeck Clamp: Required.
   11. Sump Receiver Plate: Required.
   12. Dome Material: Aluminum Cast iron PE.
   13. Perforated Gravel Guard: Stainless steel.
   14. Vandal-Proof Dome: Not required
   15. Water Dam: Not required.

B. Cast Bronze Discharge Nozzle:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Jay R. Smith Mfg. Co.
      b. MIFAB, Inc.
      c. Zurn Industries, LLC.

2.02 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Adaptors:
   1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
   2. Size: Inlet size to match parapet drain outlet.

B. Downspout Boots:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. J.R. Hoe & Sons Inc.
      b. Neenah Foundry Company.
   2. Description: Manufactured, ASTM A48/A48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
   3. Size: Inlet size to match downspout and NPS 4 outlet.

C. Conductor Nozzles:
   1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
   2. Size: Same as connected conductor.

2.03 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Jay R. Smith Mfg. Co.
      b. MIFAB, Inc.
      c. Zurn Industries, LLC.
   2. Standard: ASME A112.36.2M.
   3. Size: Same as connected branch.
   4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch No-hub, cast-iron soil pipe test tee as required to match connected piping.
   5. Closure: Countersunk or raised-head, brass plug.
   6. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Jay R. Smith Mfg. Co.
      b. WATTS.
      c. Zurn Industries, LLC.
   2. Standard: ASME A112.36.2M.
   3. Size: Same as connected branch.
   4. Type: Heavy-duty, adjustable housing Threaded, adjustable housing.
   5. Body or Ferrule: Cast iron.
   6. Clamping Device: Not required.
   7. Outlet Connection: No hub Hub with gasket Threaded.
   8. Closure: Brass plug with straight threads and gasket Brass plug with tapered threads Cast-iron plug Plastic plug.
   9. Adjustable Housing Material: Cast iron Plastic with threads.
   10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy Painted cast iron Polished bronze Rough bronze.

11. Frame and Cover Shape: Round.
12. Top Loading Classification: Extra-Heavy Duty.
13. Riser: ASTM A74, Extra-Heavy Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Plastic Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Canplas LLC.
   b. IPS Corporation.
   c. NDS Inc.
2. Size: Same as connected branch.
3. Body Material: PVC.
4. Closure Plug: PVC.
5. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

D. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Jay R. Smith Mfg. Co.
   b. MIFAB, Inc.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: No-hub, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
   a. Brass Cast iron.
   b. Countersunk or raised head.
   c. Drilled and threaded for cover attachment screw.
   d. Size: Same as, or not more than, one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

E. Test Tees:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Jay R. Smith Mfg. Co.
   b. MIFAB, Inc.
   c. Tyler Pipe; a subsidiary of McWane Inc.
2. Standard: ASME A112.36.2M and ASTM A74, ASTM A888, or CISPI 301.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk or raised head, brass.
6. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.

C. Install downspout boots at grade with top 12 inches above grade. Secure to building wall.

D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

E. Install cleanouts in building drain piping according to the following instructions unless otherwise indicated:
   1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate cleanouts at each change in direction of piping greater than 135 degrees.
   3. Locate cleanouts at base of each vertical storm piping conductor.

F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

H. Install test tees in vertical conductors and near floor.

I. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

J. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.

K. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

L. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.
   1. Comply with requirements in Section 07 84 00 " Firestopping."

3.02 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 14 13 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.03 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.04 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 14 23

SECTION 22 15 13

GENERAL-SERVICE COMPRESSED-AIR PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping and related specialties for general-service compressed-air systems:
   1. Pipes, tubes, and fittings.
   2. Joining materials.
   3. Valves.
   4. Dielectric fittings.
   5. Flexible pipe connectors.
   6. Specialties.
   7. Quick couplings.
   8. Hose assemblies.

1.02 RELATED SECTIONS

A. Section 22 00 00 “General Plumbing Requirements.”

1.03 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. CR: Chlorosulfonated polyethylene synthetic rubber.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. HDPE: High-density polyethylene plastic.

E. NBR: Acrylonitrile-butadiene rubber.

F. PE: Polyethylene plastic.

G. PVC: Polyvinyl chloride plastic.

H. High-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 150 and 200 psig.

I. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

1.04 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Compressed-air piping and support and installation shall withstand effects of seismic events determined according to SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.05 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For the following:
   1. Plastic pipes, fittings, and valves.
   2. Dielectric fittings.
   3. Flexible pipe connectors.
   4. Safety valves.
   5. Pressure regulators. Include rated capacities and operating characteristics.

6. Automatic drain valves.
7. Filters. Include rated capacities and operating characteristics.
8. Lubricators. Include rated capacities and operating characteristics.
9. Quick couplings.
10. Hose assemblies.

1.06 INFORMATIONAL SUBMITTALS

A. Brazing certificates.

B. Qualification Data: For installers.

C. Field quality-control test reports.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.08 QUALITY ASSURANCE

A. Installer Qualifications:
1. Extruded-Tee Outlet Procedure: Qualify operators according to training provided by T-DRILL Industries Inc., for making branch outlets.
2. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by Viega; Plumbing and Heating Systems.
3. Pressure-Seal Joining Procedure for Steel Piping. Qualify operators according to training provided by Victaulic Company.
4. Joining Procedures for Aluminum Piping Systems: Qualify installers according to training provided by manufacturers.

B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

D. ASME Compliance:
1. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
2. Comply with ASME B31.3, "Process Piping," for high- and low-pressure compressed-air piping.
3. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

PART 2 PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

A. Copper Tube: ASTM B88, Type K or L seamless, drawn-temper, water tube.
1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
3. Copper Unions: ASME B16.22 or MSS SP-123.
4. Press-Type Fittings, NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Apollo Flow Controls; Conbraco Industries, Inc.
      2) Elkhart Products Corporation.
      3) Viega LLC.
5. Press-Type Fittings, NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.

a. Manufacturers: Subject to compliance with requirements, provide products by the following:
1) Viega LLC.

6. Extruded-Tee Outlets: Procedure for making branch outlets in copper tube according to ASTM F2014.
a. Manufacturers: Subject to compliance with requirements, provide products by the following:
1) T-DRILL Industries Inc.

7. Grooved-End Fittings and Couplings:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Anvil International.
2) Grinnell G-Fire by Johnson Controls Company.
3) Victaulic Company.
b. Grooved-End Fittings: ASTM B75, copper tube or ASTM B584, bronze castings.
c. Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gasket for oil-free compressed air. Provide NBR gasket if compressed air contains oil or oil vapor.

B. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.02 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

E. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.03 VALVES

A. Metal Ball, Butterfly, Check, and Gate Valves: Comply with requirements in Section 22 05 23 “General Duty Valves for Plumbing Piping.”

2.04 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Capitol Manufacturing Company.
b. Matco-Norca.
c. Wilkins.
2. Description:
a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig minimum at 180 deg F.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Capitol Manufacturing Company.
      b. Matco-Norca.
      c. Wilkins.
   2. Description:
      a. Standard: ASSE 1079.
      b. Factory-fabricated, bolted, companion-flange assembly.
      c. Pressure Rating: 125 psig minimum at 180 deg F.
      d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Pipeline Seal and Insulator, Inc.
   2. Description:
      a. Nonconducting materials for field assembly of companion flanges.
      b. Pressure Rating: 150 psig.
      c. Gasket: Neoprene or phenolic.
      d. Bolt Sleeves: Phenolic or polyethylene.
      e. Washers: Phenolic with steel backing washers.

2.05 FLEXIBLE PIPE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flex-Hose Co., Inc.
   2. Flexicraft Industries.
   3. Metraflex Company.

B. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
   1. Working-Pressure Rating: 200 psig minimum.
   2. End Connections, NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
   3. End Connections, NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
   1. Working-Pressure Rating: 200 psig minimum.
   2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.
   3. End Connections, NPS 2-1/2 and Larger: Flanged steel nipple.

2.06 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.
   1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.
   1. Type: Pilot operated.

C. Air-Line Pressure Regulators: Diaphragm or pilot operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.

D. Air-Line Pressure Regulators: Diaphragm operated, aluminum alloy or plastic body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.

E. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket if wall mounting is indicated.

F. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting is indicated.

G. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock. Include mounting bracket if wall mounting is indicated.

H. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal. Include mounting bracket if wall mounting is indicated.
   1. Provide with automatic feed device for supplying oil to lubricator.

2.07 QUICK COUPLINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Aeroquip Corporation.
   2. Milton Industries, Inc.
   3. Parker Hannifin Corp.

B. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.

C. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
   1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
   2. Plug End: Straight-through type with barbed outlet for attaching hose.

D. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.
   1. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
   2. Plug End: With barbed outlet for attaching hose.

2.08 HOSE ASSEMBLIES

A. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.
   1. Hose: Reinforced double-wire-braid, CR-covered hose for compressed-air service.
   2. Hose Clamps: Stainless-steel clamps or bands.
   3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
   4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

PART 3 EXECUTION

3.01 PIPING APPLICATIONS

A. Compressed-Air Piping between Air Compressors and Receivers: Use the following piping materials for each size range:
   1. NPS 2 and Smaller: Type K or L, copper tube; wrought-copper fittings; and brazed joints.
   2. NPS 2-1/2 to NPS 4: Type K or L, copper tube; wrought-copper fittings; and brazed joints.
   3. NPS 5 and Larger: Grooved-end, Type K or L, copper tube; grooved-end copper fittings; couplings; and grooved joints.

B. Low-Pressure Compressed-Air Distribution Piping: Use the following piping materials for each size range:
   1. NPS 2 and Smaller: Type L, copper tube; wrought-copper fittings; and brazed or soldered joints.
   2. NPS 2 and Smaller: Type L, copper tube; press-type fittings; and pressure-sealed joints.
   3. NPS 2-1/2 to NPS 4: Type L, copper tube; wrought-copper fittings; and brazed or soldered joints.
   4. NPS 2-1/2 to NPS 4: Type L, copper tube; grooved-end copper fittings; couplings; and grooved joints.
   5. NPS 2-1/2 to NPS 4: Type L, copper tube; press-type fittings; and pressure-sealed joints.
   6. NPS 5 to NPS 8: Type K or L, copper tube; grooved-end copper fittings; couplings; and grooved joints.

C. High-Pressure Compressed-Air Distribution Piping: Use the following piping materials for each size range:
   1. NPS 2 and Smaller: Type K or L, copper tube; wrought-copper fittings; and brazed joints.
   2. NPS 2-1/2 to NPS 4: Type K or L, copper tube; wrought-copper fittings; and brazed or soldered joints.
   3. NPS 2-1/2 to NPS 6: Type K or L, copper tube; wrought-copper fittings; and brazed joints.
   4. NPS 2-1/2 to NPS 6: Type K or L, copper tube; grooved-end copper fittings; couplings; and grooved joints.
   5. NPS 8: Type K or L, copper tube; grooved-end copper fittings; couplings; and grooved joints.

D. Drain Piping: Use the following piping materials:
   1. NPS 2 and Smaller: Type M copper tube; wrought-copper fittings; and brazed or soldered joints.

3.02 VALVE APPLICATIONS

A. Metal General-Duty Valves: Comply with requirements and use valve types specified in "Valve Applications" Articles in Section 22 05 23 “General Duty Valves for Plumbing Piping,” according to the following:
   1. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
   2. High-Pressure Compressed Air: Valve types specified for medium-pressure compressed air.
   3. Equipment Isolation NPS 2 and Smaller: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least equal to piping system operating pressure.
   4. Grooved-end valves may be used with grooved-end piping and grooved joints.

3.03 PIPING INSTALLATION, GENERAL

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.

E. Install piping adjacent to equipment and machines to allow service and maintenance.

F. Install air and drain piping with 1 percent slope downward in direction of flow.

G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.

H. Equipment and Specialty Flanged Connections:
   1. Use steel companion flange with gasket for connection to steel pipe.
   2. Use cast-copper-alloy companion flange with gasket and brazed joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.

I. Flanged joints may be used instead of specified joint for any piping or tubing system.

J. Extended-tee outlets with brazed branch connection may be used for copper tubing, within extruded-tee connection diameter to run tube diameter ratio for tube type, according to Extruded Tee Connections Sizes and Wall Thickness for Copper Tube Table in ASTM F2014.

K. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

L. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

M. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 22 05 19 "Meters and Gages for Plumbing Piping."

N. Install piping to permit valve servicing.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install seismic restraints on piping. Seismic-restraint devices are specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.04 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

E. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B828 or CDA's "Copper Tube Handbook."

F. Extruded-Tee Outlets for Copper Tubing: Form branches according to ASTM F2014, with tools recommended by procedure manufacturer, and using operators qualified according to Part 1 "Quality Assurance" Article.

G. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.

H. Grooved Joints: Assemble couplings with housing, gasket, lubricant, and bolts. Join according to AWWA C606 for grooved joints. Do not apply lubricant to prelubricated gaskets.

I. Pressure-Sealed Joints: Join with tools recommended by fitting manufacturer, using operators qualified according to Part 1 "Quality Assurance" Article.

J. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.05 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Section 22 05 23 “General Duty Valves for Plumbing Piping."

B. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.

C. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.

D. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

3.06 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. NPS 2 and Smaller: Use dielectric unions.

C. NPS 2-1/2 to NPS 4: Use dielectric flanges.

D. NPS 5and Larger: Use dielectric flange kits.

3.07 FLEXIBLE PIPE CONNECTOR INSTALLATION

A. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.

B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.

C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

3.08 SPECIALTY INSTALLATION

A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.

B. Install air-main pressure regulators in compressed-air piping at or near air compressors.

C. Install air-line pressure regulators in branch piping to equipment and tools.

D. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor sink.

E. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters.

F. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters.

G. Install air-line lubricators in branch piping to machine tools.

H. Install quick couplings at piping terminals for hose connections.

I. Install hose assemblies at hose connections.

3.09 CONNECTIONS

A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

B. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment and machine.

3.10 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

3.11 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.12 FIELD QUALITY CONTROL

A. Perform field tests and inspections.

B. Tests and Inspections:

1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
2. Repair leaks and retest until no leaks exist.
3. Inspect filters lubricators and pressure regulators for proper operation.

C. Prepare test reports.

END OF SECTION 22 15 13

This page intentionally left blank

SECTION 22 15 19

GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Lubricated, reciprocating air compressors.

1.02 DEFINITIONS

A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in acfm.

B. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings:
   1. Include diagrams for power, signal, and control wiring.

D. Delegated-Design Submittal: For compressed-air equipment mounting.
   1. Detail fabrication and assembly of supports.
   2. Include design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.04 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For compressed-air equipment, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressed-air equipment to include in emergency, operation, and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Air-Compressor, Inlet-Air-Filter Elements: Equal to two percent of amount installed, but no fewer than units.
   2. Belts: Two for each belt-driven compressor.

1.07 FIELD CONDITIONS

A. Interruption of Existing Compressed-Air Service: Do not interrupt service to facilities occupied by Contracting Agency or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Contracting Agency no fewer than five days in advance of proposed interruption of compressed-air service.
   2. Do not proceed with interruption of compressed-air service without Contracting Agency's written permission.

1.08 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label receivers to comply with ASME Boiler and Pressure Vessel Code.

2.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment"to design compressed-air equipment mounting.

B. Seismic Performance: Compressed-air equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.03 GENERAL REQUIREMENTS FOR PACKAGED AIR COMPRESSORS AND RECEIVERS

A. General Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.

B. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
   1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
   2. Motor Controllers: Full-voltage, combination magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
   3. Control Voltage: 120-V ac or less, using integral control power transformer.
   4. Motor Overload Protection: Overload relay in each phase.
   5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
   6. Automatic control switches to alternate lead-lag compressors for duplex sequence lead-lag compressors for multiplex air compressors.
   7. Instrumentation: Include discharge-air pressure gage, air-filter maintenance indicator, hour meter, compressor discharge-air and coolant temperature gages, and control transformer.
   8. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.

C. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   1. Pressure Rating: At least as high as highest discharge pressure of connected compressors, and bearing appropriate code symbols.
   2. Interior Finish: Corrosion-resistant coating.

3. Accessories: Include safety valve, pressure gage, drain, and pressure-reducing valve.

D. Mounting Frame: Fabricate mounting and attachment to pressure vessel with reinforcement strong enough to resist packaged equipment movement during a seismic event when base is anchored to building structure.

2.04 LUBRICATED, RECIPROCATING AIR COMPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Atlas Copco.
   2. Ingersoll-Rand.
   3. Quincy Compressor.
   4. Speedaire.

B. Compressor(s): Lubricated, reciprocating-piston type with lubricated compression chamber and crankcase.
   1. Submerged gear-type oil pump.
   2. Oil filter.
   3. Combined high discharge-air temperature and low lubrication-oil pressure switch.
   4. Belt guard totally enclosing pulleys and belts.

C. Capacities and Characteristics: See equipment schedule on drawings.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

A. Equipment Mounting:
   1. Install air compressors, aftercoolers, and air dryers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 " Cast-in-Place Concrete."
   2. Install water-cooled, compressed-air aftercoolers and desiccant compressed-air dryers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 " Cast-in-Place Concrete."
   3. Comply with requirements for vibration isolation and seismic control devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment"
   4. Comply with requirements for vibration isolation devices specified in Section 22 05 48 "Vibration Controls for Plumbing Piping and Equipment."

B. Install compressed-air equipment anchored to substrate.

C. Arrange equipment so controls and devices are accessible for servicing.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Install the following devices on compressed-air equipment:
   1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
   2. Pressure Regulators: Install downstream from air compressors and dryers.
   3. Automatic Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

3.02 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 15 13 "General-Service Compressed-Air Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to machine, allow space for service and maintenance.

3.03 IDENTIFICATION

A. Identify general-service air compressors and components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.04 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check for lubricating oil in lubricated-type equipment.
   3. Check belt drives for proper tension.
   4. Verify that air-compressor inlet filters and piping are clear.
   5. Check for equipment vibration-control supports and flexible pipe connectors, and verify that equipment is properly attached to substrate.
   6. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure, but not higher than rating of system components.
   7. Check for proper seismic restraints.
   8. Drain receiver tanks.
   9. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   10. Test and adjust controls and safeties.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Contracting Agency's maintenance personnel to adjust, operate, and maintain air compressors, aftercoolers, and air dryers.

END OF SECTION 22 15 19

SECTION 22 16 19

DISINFECTION OF POTABLE WATER SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The furnishing of all labor and materials for disinfection of the potable water system. Potable water systems are those systems which carry domestic water from the supply main without isolation of the branch by a backflow prevention device. Install all plumbing fittings and valves necessary to perform the disinfection.

B. This section also includes the furnishing of all labor and materials to sample water in system following completion of procedure and provide bacteriological analysis of the water.

1.02 QUALIFICATIONS

A. Disinfection: Disinfection shall be done by a commercial disinfection company approved by the Client. Submit to the Client's Representative the name of the proposed company for approval.

B. Bacteriological Analysis: Water testing shall be done by a laboratory approved by the State Department of Health Services. Submit for approval the name of the proposed laboratory as well as the proposed number and location of samples.

C. Provide a certificate of completion per Part B attached standard chlorination report which denotes the lines disinfected, the concentration applied and the amount and type of disinfection agent used, and that disinfection is in accordance with AWWA C-601 and State Health Department requirements.

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:

1. “No Exception Taken”.
2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.

PART 2 PRODUCTS

2.01 MATERIALS

A. Use an approved chlorine agent, applied in liquid form into the system being disinfected. Chlorine gas or a hypochlorite solution may be used to make up the disinfecting liquid.

PART 3 EXECUTION

3.01 PRELIMINARY PREPARATION OF THE SYSTEM

A. Provide within 3 feet of the supply main, an injection port for introducing the chlorine solution and a gate valve upstream from the injection port.

B. There shall be no dead-end sections in the system exceeding 18 inches in length. All branches within the system shall lead to an outlet for bleeding and flushing.

C. After final pressure tests, open each fixture or outlet to maximum flow and run until the discharge water is free from particulates.

3.02 CHLORINATION PROCEDURE

A. Notify the University's Representative at least five working days prior to the start date of chlorination per Part A attached chlorination report.

B. Install all fixtures to be served by the potable water system before start of chlorination.

C. Prior to injection, place signs on each fixture being treated, reading "Heavily Chlorinated Water - Do Not Use."

D. Introduce the chlorine into the supply stream at a rate to provide a uniform concentration of chlorine in the entire system. Maintain at least 50 ppm chlorine level at each fixture after a hold period of 24 hours.

E. Draw the injected chlorine in the system through each outlet and fixture until the specified concentration level is reached. Then close all valves including the service cock and supply valve. Keep the system closed during the 24 hour hold period.

F. The Client will require a test for the residual concentration in the system at the end of 24 hours. Release no water from the system until these required samples are taken. A minimum concentration of 50 ppm of chlorine is required at all chosen sampling points.

G. After approval to proceed, flush the system at a relatively high velocity to remove the injected chlorine to a concentration in the system of no more than 0.5 ppm above that in the normal supply.

H. After approval to proceed, secure the entire system for at least three days prior to taking samples for bacteriological analysis.

3.03 SAMPLING AND NOTIFICATION

A. At the completion of the three-day hold period, take bacteriological water samples with observation by the Client's Representative.

B. Sample bottles must be provided by the approved laboratory. After the samples have been collected, the Client's Representative may allow temporary use of the water system pending results of the bacteriological analysis of the samples. The system cannot be used unless such allowance in writing is given.

C. Upon completion of sampling, submit the certificate of completion to the Client's Representative for approval.

3.04 ANALYSIS

A. Perform qualitative and quantitative bacterial analysis on the water samples and submit a laboratory report. The report must include the presence of any E. Coli bacteria in a 100 ml sample (this must be negative to be acceptable) and a total plate count of bacteria per cc of the sample (this must be less than 100, or equal to the supply).

3.05 FINAL ACCEPTANCE

A. Upon satisfactory completion of all procedures and receipt of acceptable bacteriological results, written approval of the system will be provided by the Client's Representative per Part C attached standard chlorination report. Failure to fully comply with the above procedures will result in a requirement to repeat the procedure until acceptable results are achieved, at no additional cost to the Client.

END OF SECTION 22 16 19

SECTION 22 33 00

ELECTRIC DOMESTIC WATER HEATERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial, electric, storage, domestic water heaters.

B. Domestic water heater accessories.

1.02 RELATED REQUIREMENTS

A. Seismic Performance: Commercial domestic water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.03 DEFINITIONS

A. HI-1.1-1.2: ANSI/HI 1.1-1.2 - Centrifugal Pumps - Definitions

B. HI-1.3: Rotodynamic (Centrifugal) Pump Applications (ANSI/HI 1.3)

1.04 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.05 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For electric, domestic water heaters, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Certificates: For each type of commercial domestic water heater, from manufacturer.

C. Domestic water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Source Quality Control Reports: Provide.

E. Field Quality Control Reports: Provide.

F. Warranty: Sample of special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water heaters to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Fabricate and label, domestic water heaters to comply with ASHRAE/IESNA 90.1.

C. ASME Compliance:
   1. Where ASME-code construction is indicated, fabricate and label commercial, domestic water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, “Drinking Water System Components - Health Effects.”

1.08 COORDINATION

A. Concrete Bases: Coordinate sizes and locations of concrete bases with actual equipment provided.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic water heaters that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including storage tank and supports.
      b. Faulty operation of controls.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Periods: From date of Substantial Completion.
      a. Commercial, Electric, Storage, Domestic Water Heaters:
         1) Storage Tank: Three years.
         2) Controls and Other Components: One year(s).

PART 2 PRODUCTS

2.01 COMMERCIAL, ELECTRIC/HEAT PUMP, STORAGE, DOMESTIC WATER HEATERS (HPWH-X)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. RUDD
   b. Rheem.
   c. Smith, A. O.
2. Standard: UL 1453.
3. Storage-Tank Construction: Non- ASME-code, steel vertical arrangement.
   a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
      1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
   b. Pressure Rating: 150 psig.
   c. Interior Finish: Comply with NSF 61 barrier materials for potable water tank linings, including extending lining material into tappings.
4. Factory-Installed Storage-Tank Appurtenances:
   a. Anode Rod: Replaceable magnesium.
   b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
   c. Insulation: Comply with ASHRAE/IESNA 90.1.
   d. Jacket: Steel with enameled finish.
   e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
   f. Temperature Control: Adjustable thermostat.
   g. Safety Controls: High-temperature-limit and low water cutoff devices or systems.
   h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
   i. Heat Pump: LCD display screen, Pre-charged R-134a refrigerant system, 20degF to 110degF ambient operating range, capable of delivering 150degF water in hybrid (heat pump & electric) operating mode.

2.02 DOMESTIC WATER HEATER ACCESSORIES

A. Domestic Water Compression Tanks:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AMTROL Inc.
      b. Smith, A. O.
      c. Taco.
   2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
   3. Construction:
      a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
      b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
      c. Air-Charging Valve: Factory installed.
   4. Capacity and Characteristics: See schedule on Drawings.
   5. ASME Requirements: Unless otherwise scheduled on Drawings, the following minimum requirements shall apply to all unfired pressure vessel tanks on project:
      a. Unfired pressure vessels located in projects having places of public assembly and having a volume of 1.50 cubic feet (11.25 gallons) or more shall be ASME labeled.
      b. Unfired pressure vessels located in projects without public assembly places and having a volume of 5.00 cubic feet (37.5 gallons) or more shall be ASME labeled.
      c. The above requirements shall be superseded by the code requirements of the local jurisdiction or authority having jurisdiction. Contractor shall comply with most stringent requirements.

B. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
   1. Electric, Domestic water Heaters: ANSI Z21.22/CSA 4.4-M.

C. Domestic Water Heater Mounting Anchors: Manufacturer’s factory-fabricated steel bracket for floor mounting, capable of supporting domestic water heater and water. Provide seismic straps.

2.03 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled domestic water heaters and storage tanks specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatic Test: Hydrostatically test commercial domestic water heaters and storage tanks to minimum of one and one-half times pressure rating before shipment.

C. Defective Water Heaters: Domestic water heaters will be considered defective if they do not pass tests and inspections.

D. Test and Inspection Reports: Prepare test and inspection reports.

PART 3 EXECUTION

3.01 DOMESTIC WATER HEATER INSTALLATION

A. Commercial, Domestic water Heater Mounting: Install commercial domestic water heaters on concrete base. Comply with requirements for concrete base specified in Section 03 30 00 “Cast-in-Place Concrete.”
   1. Maintain manufacturer’s recommended clearances.
   2. Arrange units so controls and devices that require servicing are accessible.
   3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18.00-inch centers around the full perimeter of concrete base.
   4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
6. Install anchor bolts to elevations required for proper attachment to supported equipment.
7. Anchor domestic water heaters to substrate.

B. General: Install domestic water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
   1. Install shutoff valves on domestic water-supply piping to domestic water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."

C. Combination Temperature Pressure Relief Valves: Install combination temperature-and-pressure relief valves in water piping for domestic water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Drain Piping: Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 11 19 "Domestic Water Piping Specialties."

E. Thermometers: Install thermometer on outlet piping of domestic water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gauges for Plumbing Piping."

F. Filling: Fill domestic water heaters with water.

G. Compression Tanks: Charge domestic water compression tanks with air.

3.02 CONNECTIONS

A. Domestic Water Piping: Comply with requirements for domestic water piping specified in Section 22 11 16 "Domestic Water Piping."

B. Service and Maintenance: Where installing piping adjacent to electric, domestic water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic water heaters.

3.03 IDENTIFICATION

A. System Components: Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
   2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Defective Units: Domestic water heaters will be considered defective if they do not pass tests and inspections.

C. Reports: Prepare test and inspection reports.

3.05 DEMONSTRATION

A. Training: Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain domestic water heaters.

END OF SECTION 22 33 00

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water closets.
B. Water closet Flushometer valves and tanks.
C. Toilet seats.
D. Urinals.
E. Urinal Flushometer valves.
F. Lavatories.
G. Lavatory Faucets.
H. Service sinks.
I. Utility sinks.
J. Handwash sinks.
K. Sink faucets.
L. Shower faucets.
M. Group Showers.
N. Laminar-flow, faucet-spout outlets.
O. Lavatory and Sink Supply Fittings.
P. Lavatory and Sink Waste Fittings.
Q. Lavatories.
R. Grout.
S. Supports. Service basins.
T. Service sinks.
U. Utility sinks.
V. Handwash sinks.
W. Sink faucets Individual shower receptors.
X. Shower faucets.

1.02 RELATED REQUIREMENTS

A. Section 22 45 00 "Emergency Plumbing Fixtures" for Eyewash and shower units.

1.03 DEFINITIONS

A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.
B. Remote Water Closet: Located more than 30 feet from other drain line connections or fixture and where less than 1.5 drainage fixture units are upstream of the drain line connection.

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
    1. “No Exception Taken”.
    2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
   1. Water Closet Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.
   2. Urinal Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.
   3. Waterless Urinal Trap-Seal Cartridges: Equal to 200 percent of amount of each type installed, but no fewer than 12 of each type.
   4. Waterless Urinal Trap-Seal Liquid: Equal to 1 gal. for each urinal installed.

PART 2 PRODUCTS

2.01 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS (P-1)

A. Water Closets: Floor mounted, bottom outlet, top spud.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard.
      b. Kohler Co.
      c. Sloan Valve Company.
      d. Zurn Industries, LLC.
   2. Bowl:
      a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
      b. Material: Vitreous china.
      c. Type: Siphon jet.
      d. Style: Flushometer valve.
      e. Height: Handicapped/elderly, complying with ICC/ANSI A117.1.
      f. Rim Contour: Elongated.
      g. Water Consumption: 1.28 gal. per flush.
      h. Spud Size and Location: NPS 1-1/2; top.
      i. Color: White.
   3. Bowl-to-Drain Connecting Fitting: ASTM A1045 or ASME A112.4.3.

2.02 FLUSHOMETER VALVES

A. Battery-Powered, Solenoid-Actuator, Piston Flushometer Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard.
      b. Delany Products.
      c. Gerber Plumbing Fixtures LLC.
      d. Hydrotek International, Inc.
      e. Kohler Co.
      f. Moen Incorporated.
      g. Sloan Valve Company.
      h. Stern Engineering Ltd.

i. TOTO USA, INC.
j. Zurn Industries, LLC.
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed
9. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
10. Trip Mechanism: Battery-powered electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
11. Consumption: 1.28 gal. per flush.
12. Minimum Inlet: NPS 1.
13. Minimum Outlet: NPS 1-1/4.

2.03 TOILET SEATS

A. Toilet Seats
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bemis Manufacturing Company.
b. Kohler Co.
c. Olsonite Seat Co.
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

2.04 SUPPORTS

A. Water Closet Carrier:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Zurn Industries, LLC.
b. JR Smith
2. Standard: ASME A112.6.1M.
3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

2.05 WALL-HUNG URINALS

A. Urinals: Wall hung, back outlet, siphon jet, accessible.
1. Manufactures:
a. Kohler Co.
b. Zurn Industries, LLC.
c. American Standard
2. Fixture:
a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet.

d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
e. Water Consumption: Low.
f. Spud Size and Location: NPS 3/4; top.
g. Outlet Size and Location: NPS 2; back.
h. Color: White.

3. Waste Fitting:
   a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
   b. Size: NPS 2.
4. Support: Type I Urinal Carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.
5. Urinal Mounting Height: Handicapped/elderly according to ICC A117.1.

2.06 URINAL FLUSHOMETER VALVES

A. Battery-Powered, Solenoid-Actuator, Piston Flushometer Valves:
   1. Manufactures:
      a. Sloan Valve Company
      b. Zurn Industries, LLC.
      c. Hydrotek International, Inc.
      d. Moen Commercial
   2. Standard: ASSE 1037.
   3. Minimum Pressure Rating: 125 psig.
   4. Features: Include integral check stop and backflow-prevention device.
   5. Material: Brass body with corrosion-resistant components.
   6. Exposed Flushometer-Valve Finish: Chrome plated.
   7. Panel Finish: Chrome plated or stainless steel.
   8. Style: Exposed
   9. Actuator: Solenoid complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
   10. Trip Mechanism: Battery-powered electronic sensor complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
   11. Consumption: 0.125 gal. per flush.
   12. Minimum Inlet: NPS 3/4.
   13. Minimum Outlet: NPS 1-1/4.

2.07 SUPPORTS

A. Type I Urinal Carrier:
   1. Standard: ASME A112.6.1M.

B. Type II Urinal Carrier:
   1. Standard: ASME A112.6.1M.

C. Type I Sink Carrier:
   1. Standard: ASME A112.6.1M.

2.08 LAVATORIES

2.09 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

A. Lavatory (P-15): Oval, self-rimming, vitreous china, counter mounted.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard.
      b. Kohler Co.
      c. Zurn Industries, LLC.
      d. Sloan
   2. Fixture:
      a. Standard: ASME A112.19.2/CSA B45.1.

b. Type: Self-rimming for above-counter mounting.
c. Nominal Size: Oval, As scheduled
d. Faucet-Hole Punching: As scheduled.
e. Faucet-Hole Location: Top.
f. Color: White.
g. Mounting Material: Sealant.

3. Faucet: as scheduled

2.10 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory (P-2): Vitreous china, wall mounted, with back.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Standard.
b. Kohler Co.
c. Zurn Industries, LLC.
d. Sloan
2. Fixture:
a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For wall hanging.
c. Nominal Size: As Scheduled.
d. Faucet-Hole Punching: As Scheduled.
e. Faucet-Hole Location: Top.
f. Color: White.
g. Mounting Material: Chair carrier.
3. Faucet: As Scheduled.
4. Support: Type II, concealed-arm lavatory carrier. Include rectangular, steel uprights.
5. Lavatory Mounting Height: Handicapped/elderly according to ICC A117.1.

2.11 SOLID-BRASS, MANUALLY OPERATED FAUCETS

A. NSF Standard: Comply with NSF 372 for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Manual-type, single-control mixing, commercial, solid-brass valve.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Chicago Faucets; Geberit Company.
b. Just Manufacturing.
c. T&S Brass and Bronze Works, Inc.
d. Sloan
e. Zurn
2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
4. Body Type: Centerset Single hole.
5. Body Material: Commercial, solid brass.
6. Finish: Polished chrome plate.
7. Maximum Flow Rate: 1.0gpm.
8. Maximum Flow: 0.25 gal. per metering cycle.
9. Mounting Type: Deck, exposed.
10. Valve Handle(s): Single lever Cross
11. Spout: Rigid type.
12. Spout Outlet: Laminar flow.
13. Operation: Compression, manual.
14. Drain: chrom grid drain

2.12 SOLID-BRASS, AUTOMATICALLY OPERATED LAVATORY FAUCETS

A. NSF Standard: Comply with NSF 372 for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Automatic-type, hard-wired, electronic-sensor-operated, mixing, solid-brass valve.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Chicago Faucets; Geberit Company.
      b. Sloan Valve Company.
      c. Zurn Industries, LLC.
      d. Just
   2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
   3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
   5. Body Type: Single hole.
   6. Body Material: Commercial, solid brass.
   7. Finish: Polished chrome plate.
   8. Maximum Flow Rate: 1.5 gpm.
   9. Mounting Type: Deck, concealed.
   10. Spout: Rigid type.
   11. Spout Outlet: Spray.
   12. Drain: Chrome plated grid drain.

2.13 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

A. NSF Standard: Comply with NSF 372 for faucet-spout-outlet materials that will be in contact with potable water.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AM Conservation Group, Inc.
   2. Chronomite Laboratories, Inc.
   3. NEOPERL, Inc.
   4. T&S Brass and Bronze Works, Inc.

C. Description: Chrome-plated-brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.14 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:
   1. NPS 1/2.
   2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

2.15 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:
   1. Size: NPS 1-1/2 by NPS 1-1/4.
   2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.
   3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

2.16 SUPPORTS

A. Type II Lavatory Carrier:
   1. Standard: ASME A112.6.1M.

B. Type III Lavatory Carrier:
   1. Standard: ASME A112.6.1M.

2.17 COMMERCIAL SINKS

2.18 SERVICE SINKS

A. Service Sinks (P-3): Floor set molded stone.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard.
      b. Kohler Co.
      c. Zurn Industries, LLC.
      d. Fiat
   2. Fixture:
      a. Standard: ASME A112.19.1/CSA B45.2.
      b. Type: Floor set
      c. Back: Two faucet holes.
      d. Nominal Size: as scheduled
      e. Color: White.
      f. Mounting: NPS 3 P-trap standard with grid strainer inlet, cleanout, and floor flange.
      g. Rim Guard: On front and sides.
   3. Faucet: as scheduled
   4. Support: floor set

2.19 STAINLESS SINKS

A. Service Sinks (P-6): Stainless Steel drop in
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elkay
      b. Just
   2. Fixture:
      a. As scheduled
   3. Faucet: as scheduled

2.20 STAINLESS SINKS

A. Service Sinks (P-9): Stainless Steel wall hung washup sink
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elkay
      b. Just
   2. Fixture:
      a. As scheduled
   3. Faucet: as scheduled

2.21 SINK FAUCETS

A. NSF Standard: Comply with NSF 372 for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: Manual type, two lever handle mixing valve.
   1. Commercial, Solid-Brass Faucets:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Chicago Faucets; Geberit Company.
         2) Sloan Valve Company.
         3) T&S Brass and Bronze Works, Inc.
   2. General: as scheduled.

2.22 SUPPORTS

A. Type II Sink Carrier:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Jay R. Smith Mfg. Co.
      b. Josam Company.
      c. MIFAB, Inc.
   2. Standard: ASME A112.6.1M.

2.23 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:
   1. NPS 1/2.
   2. ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

2.24 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.

C. Trap:
   1. Size: NPS 1-1/2.
   2. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.
   3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

2.25 GROUT

A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.26 INDIVIDUAL SHOWERS

A. Individual FRP Showers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Aqua Glass Corporation.
      b. Clarion Bathware.
      c. Swan Corporation (The).
      d. Freedom Showers
   2. General: FRP, accessible, shower enclosure with faucet and receptor and appurtenances.
   3. Standard: ANSI Z124.1.2.
   4. Type: One-piece unit without top.
   5. Style: Handicapped/wheelchair.
   6. Faucet: as scheduled.
   7. Nominal Size and Shape: as scheduled
   8. Color: White.
   9. Bathing Surface: Slip resistant according to ASTM F462.
   10. Outlet: Drain with NPS 2 outlet.
   11. Shower Rod and Curtain: Required.
   12. Grab Bar: ASTM F446, mounted on support area back wall.

2.27 SHOWER FAUCETS

A. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for shower materials that will be in contact with potable water.

B. Shower Faucets:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Acorn Engineering Company.
      b. Chicago Faucets; Geberit Company.
      c. Leonard Valve Company.
      d. Symmons
   2. Description: Single-handle, pressure-balance mixing valve with hot- and cold-water indicators; check stops; and shower head.
   3. Faucet:
      a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016.
      b. Body Material: Solid brass.
      c. Finish: Polished chrome plate.
      d. Shower-Arm, Flow-Control Fitting: 1.5 gpm.
      e. EPA WaterSense: Required.
      f. Mounting: Exposed.
      g. Operation: Single-handle, twist or rotate control.
      h. Antiscald Device: Integral with mixing valve.
      i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
   4. Supply Connections: NPS 1/2.
   5. Shower Head:
      a. Standard: ASME A112.18.1/CSA B125.1.
      b. Type: Flexible hose, wand and mounting slide. 5 ft hose.
      c. Shower Head Material: Metallic with chrome-plated finish.
      d. Spray Pattern: Adjustable.
      e. Integral Volume Control: Required.
      f. Shower-Arm, Flow-Control Fitting: 1.5 gpm.
      g. Temperature Indicator: Not required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Water-Closet Installation:
   1. Install level and plumb according to roughing-in drawings.
   2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
   3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:
   1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
   2. Use carrier supports with waste-fitting assembly and seal.
   3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
   4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:
   1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
   2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
   3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
   4. Install actuators in locations that are easy for people with disabilities to reach.
   5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:
   1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
   2. Install deep-pattern escutcheons if required to conceal protruding fittings.
   3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

F. Joint Sealing:
   1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
   2. Match sealant color to water-closet color.
   3. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

3.03 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping & Fittings."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.04 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.05 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Contracting Agency.

D. Fixtures shall be protected during construction from any damages. Refinished fixtures will not be acceptable under any conditions.

END OF SECTION 22 40 00

This page intentionally left blank

SECTION 22 45 00
EMERGENCY PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Emergency showers.

B. Eyewash equipment.

C. Eye/face wash equipment.

D. Combination units.

E. Supplemental equipment.

F. Water-tempering equipment.

1.02 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.

D. Tepid: Moderately warm.

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 22 00 00 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

C. Shop Drawings:
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
   4. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.

B. Field quality-control test reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Flushing-Fluid Solution: Separate lot and equal to at least 200 percent of amount of solution installed for each self-contained unit.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ISEA Standard: Comply with ISEA Z358.1.

C. NSF Standard: Comply with NSF 61 and NSF 372, for fixture materials that will be in contact with potable water.

D. Regulatory Requirements: Comply with requirements in ICC A117.1,; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

2.02 COMBINATION UNITS

A. Standard, Plumbed Emergency Shower with Eyewash Combination Units:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Acorn Safety.
      b. Bradley Corporation.
      c. Encon Safety Products.
      d. Guardian Equipment Co.
      e. Haws Corporation.
      f. Sellstrom Manufacturing Company.
      g. Speakman Company.
      h. WaterSaver Faucet Co.
   2. Piping:
      a. Material: Chrome-plated brass or stainless steel or PVC.
      b. Unit Supply: NPS 1-1/4 minimum.
      c. Unit Drain: Outlet at back or side near bottom.
   3. Shower:
      a. Capacity: Not less than 20 gpm for at least 15 minutes.
      b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
      c. Control-Valve Actuator: Pull rod or Treadle.
      d. Shower Head: 8-inch- minimum diameter, chrome-plated brass or stainless steel or plastic.
      e. Mounting: Pedestal.
   4. Eyewash Unit:
      a. Capacity: Not less than 0.4 gpm for at least 15 minutes.
      b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
      c. Control-Valve Actuator: Paddle.
      d. Spray-Head Assembly: Two receptor-mounted spray heads.
      e. Receptor: Chrome-plated brass or stainless-steel or Plastic bowl.
      f. Mounting: Attached shower pedestal.
      g. Drench-Hose Option: May be provided instead of eyewash unit.
         1) Capacity: Not less than 0.4 gpm for at least 15 minutes.
         2) Drench Hose: Hand-held spray head with squeeze-handle actuator and hose.
         3) Mounting: Bracket on shower pedestal.

B. Accessible, Plumbed Emergency Shower with Eyewash Combination Units:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Acorn Safety.
      b. Bradley Corporation.
      c. Encon Safety Products.
      d. Guardian Equipment Co.
      e. Haws Corporation.
      f. Sellstrom Manufacturing Company.
      g. Speakman Company.
      h. WaterSaver Faucet Co.
   2. Piping:
      a. Material: Chrome-plated brass or stainless steel or PVC.
      b. Unit Supply: NPS 1-1/4 minimum.
      c. Unit Drain: Outlet at back or side near bottom.
   3. Shower:
      a. Capacity: Not less than 20 gpm for at least 15 minutes.
      b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
      c. Control-Valve Actuator: Pull rod.
      d. Shower Head: 8-inch- minimum diameter, chrome-plated brass or stainless steel or plastic.
      e. Mounting: Pedestal.
   4. Eyewash Unit:
      a. Capacity: Not less than 0.4 gpm for at least 15 minutes.
      b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
      c. Control-Valve Actuator: Paddle.
      d. Spray-Head Assembly: Two receptor-mounted spray heads.
      e. Receptor: Chrome-plated brass or stainless-steel or Plastic bowl.
      f. Mounting: Attached shower pedestal.
      g. Drench-Hose Option: May be provided instead of eyewash unit.
         1) Capacity: Not less than 0.4 gpm for at least 15 minutes.
         2) Drench Hose: Hand-held spray head with squeeze-handle actuator and hose.
         3) Mounting: Bracket on shower pedestal.

C. Standard, Plumbed Emergency Shower with Eye/Face Wash Combination Units:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Acorn Safety.
      b. Bradley Corporation.
      c. Encon Safety Products.
      d. Guardian Equipment Co.
      e. Haws Corporation.
      f. Sellstrom Manufacturing Company.
      g. Speakman Company.
      h. WaterSaver Faucet Co.
   2. Piping:
      a. Material: Chrome-plated brass or stainless steel or PVC.
      b. Unit Supply: NPS 1-1/4 minimum.
      c. Unit Drain: Outlet at back or side near bottom.
   3. Shower:
      a. Capacity: Not less than 20 gpm for at least 15 minutes.
      b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
      c. Control-Valve Actuator: Pull rod or Treadle.

d. Shower Head: 8-inch- minimum diameter, chrome-plated brass or stainless steel or plastic.
e. Mounting: Pedestal.

4. Eye/Face Wash Unit:
a. Capacity: Not less than 3.0 gpm for at least 15 minutes.
b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
c. Control-Valve Actuator: Paddle.
d. Spray-Head Assembly: Two or four receptor-mounted spray heads.
e. Receptor: Chrome-plated brass or stainless-steel or Plastic bowl.
f. Mounting: Attached shower pedestal.
g. Drench-Hose Option: May be provided instead of eye/face wash unit.
1) Capacity: Not less than 3.0 gpm for at least 15 minutes.
2) Drench Hose: Hand-held spray head with squeeze-handle actuator and hose.
3) Mounting: Bracket on shower pedestal.

D. Accessible, Plumbed Emergency Shower with Eye/Face Wash Combination Units:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acorn Safety.
b. Bradley Corporation.
c. Encon Safety Products.
d. Guardian Equipment Co.
e. Haws Corporation.
f. Sellstrom Manufacturing Company.
g. Speakman Company.
h. WaterSaver Faucet Co.

2. Piping:
a. Material: Chrome-plated brass or stainless steel or PVC.
b. Unit Supply: NPS 1-1/4 minimum.
c. Unit Drain: Outlet at back or side near bottom.

3. Shower:
a. Capacity: Not less than 20 gpm for at least 15 minutes.
b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
c. Control-Valve Actuator: Pull rod.
d. Shower Head: 8-inch- minimum diameter, chrome-plated brass or stainless steel or plastic.
e. Mounting: Pedestal.

4. Eye/Face Wash Unit:
a. Capacity: Not less than 3.0 gpm for at least 15 minutes.
b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
c. Control-Valve Actuator: Paddle.
d. Spray-Head Assembly: Two or four receptor-mounted spray heads.
e. Receptor: Chrome-plated brass or stainless-steel or Plastic bowl.
f. Mounting: Attached to shower pedestal.
g. Drench-Hose Option: May be provided instead of eye/face wash unit.
1) Capacity: Not less than 3.0 gpm for at least 15 minutes.
2) Drench Hose: Hand-held spray head with squeeze-handle actuator and hose.
3) Mounting: Bracket on shower pedestal.

2.03 SUPPLEMENTAL EQUIPMENT

A. Self-Contained, Personal Eyewash Units:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bradley Corporation.

b. Encon Safety Products.
c. Guardian Equipment Co.
d. Haws Corporation.
e. Sellstrom Manufacturing Company.
f. Speakman Company.

2. Capacity: Not less than 0.4 gpm.
3. Pressure Tank: 5 gal., stainless steel, cylindrical, with pressure gage and base suitable for on-floor installation.
4. Flushing Fluid: Medically acceptable solution manufactured and labeled according to applicable regulations.
5. Spray-Head Assembly: Chrome-plated copper alloy or stainless-steel piping with flow regulator; paddle-actuated, stay-open control valve; and two spray heads mounted on tank.

B. Deck-Mounted, Plumbed Drench Hoses:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acorn Safety.
b. Bradley Corporation.
c. Encon Safety Products.
d. Guardian Equipment Co.
e. Haws Corporation.
f. Speakman Company.
g. Stingray Systems LLC.
h. WaterSaver Faucet Co.
2. Capacity: Not less than 0.4 gpm.
3. Supply Fitting: NPS 1/2 brass with flow regulator.
4. Drench Hose: Hand-held spray head with squeeze-handle actuation and hose.
5. Mounting: In hole in deck.

C. Wall-Mounted, Plumbed Drench Hoses:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acorn Safety.
b. Bradley Corporation.
c. Encon Safety Products.
d. Guardian Equipment Co.
e. Haws Corporation.
f. Sellstrom Manufacturing Company.
g. Speakman Company.
h. WaterSaver Faucet Co.
2. Capacity: Not less than 3.0 gpm for at least 15 minutes.
3. Supply Fitting: NPS 1/2 brass with flow regulator.
4. Drench Hose: Hand-held spray head with squeeze-handle actuation and hose.
5. Mounting: Wall bracket.

2.04 WATER-TEMPERING EQUIPMENT

A. Hot- and Cold-Water, Water-Tempering Equipment:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acorn Safety.
b. Armstrong International, Inc.
c. Bradley Corporation.
d. Encon Safety Products.
e. Guardian Equipment Co.
f. Haws Corporation.

g. Lawler Manufacturing Company, Inc.
h. Leonard Valve Company.
i. POWERS; A WATTS Brand.
j. Speakman Company.
k. Stingray Systems LLC.
l. WATTS.

2. Description: Factory-fabricated equipment with thermostatic mixing valve.
   a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.
   b. Supply Connections: For hot and cold water.

B. Steam and Cold-Water, Water-Tempering Equipment:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Encon Safety Products.
   b. Haws Corporation.
   c. Therm-Omega-Tech, Inc.
2. Description: Factory-fabricated equipment with thermostatic mixing valve.
   a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, steam controls, heat exchanger, high-temperature-limit and freeze-protection devices, metal piping, and corrosion-resistant enclosure.
   b. Supply Connections: For steam and cold water.

C. Electric Water-Tempering Equipment:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Chronomite Laboratories, Inc.
   b. Haws Corporation.
2. Description: Factory-fabricated equipment with electric heating.
   a. Heating System: Electric, designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, heating coils, high-temperature-limit device, metal piping, and corrosion-resistant enclosure.
      1) Electrical Characteristics: 208 V ac 38 A, 220 V ac 40 A or 277 V ac, 32 A, single phase, 60 Hz.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures, to facilitate maintenance of the equipment. Use ball or gate valve if specific type valve is not indicated. Install valves chained or

locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Section 22 05 23 “General Duty Valves for Plumbing Piping.”

1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 22 11 16 "Domestic Water Piping."

F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

G. Install trap and waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system. Comply with requirements for waste piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

H. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system. Comply with requirements for waste piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

I. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

J. Fill self-contained fixtures with flushing fluid.

3.03 CONNECTIONS

A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment. Comply with requirements for cold-water piping specified in Section 22 11 16 "Domestic Water Piping."

B. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Section 22 11 16 "Domestic Water Piping."

C. Connect cold water and electrical power to electric heating water-tempering equipment. Comply with requirements for cold-water piping specified in Section 22 11 16 "Domestic Water Piping."

D. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary waste and vent piping. Comply with requirements for waste piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

E. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste or storm drainage piping.

F. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.04 IDENTIFICATION

A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.05 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

B. Tests and Inspections:
   1. Perform each visual and mechanical inspection.
   2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.06 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION 22 45 00

SECTION 22 70 00

VEHICLE WASH SYSTEM

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 22 00 00 “General Plumbing Requirements.”

1.02 SCOPE

A. Provide a complete vehicle wash system which recycles water to provide hot and cold vehicle washing.

B. The vehicle wash system is designed to provide high-volume cold-water and high-pressure hot water impingement vehicle wash in wash bay. System incorporates a filtration system for effective recovery of solids, oils, hydrocarbons, metals, chemicals, organics and bacterias. System is designed to operate closed-loop for full recycle operation.

C. Work includes but is not necessarily limited to the following:
   1. Provide a solid settling tank and a sump pump that will be mounted by contractor at the final compartment of Contracting Agency provided in-ground oil/water interceptor.
   2. Provide a water cannon and a remote equipment module (REM) for high-volume cold water supply from settling tank to the REM with hose reel.
   3. Provide a filtration system, including a solids filter and a dual polishing filtration system for contaminant recovery.
   4. Provide a water cannon and a remote equipment module (REM) for high-pressure hot water supply from the filtration system to the REM with hose reel.Provide an overflow drain connection at the dual polishing filtration system and route it to an Contracting Agency provided in-ground overflow storage tank that also connects to the oil/water interceptor.
   5. Provide backflush drain connections at solid settling tank, solid filter and the polishing filtration system. Manifold and route drains to the first compartment of Contracting Agency provided in-ground oil/water interceptor.

D. Labor, materials, services, equipment, and appliances required for completion of tasks as indicated on drawing or in specification or as inherently necessary to prepare spaces and systems for new installations as follows:
   1. Vehicle wash system.

1.03 SUBMITTALS

A. The manufacturer, contractor or supplier shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of that particular specification section.

B. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section.

C. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

D. Note that prior to acceptance of submittals for review, a submittal schedule shall be submitted to the Contracting Agency.

E. Submit all division 22 shop drawings and product data grouped and referenced by the specification technical section numbers in one complete submittal package. Individual or partial submittals are not acceptable and will be returned without review.

F. Shop Drawings:
   1. Provide all shop drawings in latest version of Revit/AutoCAD format and PDF format.
   2. Drawings shall be a 30 inches by 42 inches in size with a minimum scale of 1/4-inch per foot, except as specified otherwise.
   3. Include installation details of equipment indicating proposed location, layout and arrangement, accessories, piping, and other items that must be shown to assure a coordinated installation.

4. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
5. If equipment is disapproved, revise drawings to show acceptable equipment and resubmit.
6. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Contracting Agency bearing the Contracting Agency stamp of "Reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the Contracting Agency without additional compensation.

G. Whenever more than one manufacturer's product is specified, the first named product is the basis of design used in the Work and the use of alternate-named manufacturer's products or substitutes may require modifications in that design.

H. Proposed Products List: Include Products as required by the individual section in this Division.

I. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Contracting Agency bearing the Contracting Agency stamp of "Reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the Contracting Agency without additional compensation.

J. Manufacturer's Data: For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, certified equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.

1.04 PROJECT RECORD DOCUMENTS

A. Refer to Section 1-05.5(2) for additional requirements.
1. All changes, deviations and information recorded on the "Project Record Drawings" set during Construction shall be redrafted onto the latest version of AutoCAD or Revit, where applicable.
2. Submit completed shop drawings to the Contracting Agency prior to completion in AutoCAD format. Contractor hand marked or drafted redlined "Project Record Drawings" will not be accepted.

1.05 PRODUCT ALTERNATIVES OR SUBSTITUTIONS

A. Refer to Section 1-06.7 for additional requirements.

1.06 OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel.

1.07 MANUFACTURER S RECOMMENDATIONS

A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.
1. Hydro Engineering Inc. (HEI, Basis of Design)

PART 2 PRODUCTS

2.01 TANKS

A. Solids Settling Tank shall be 500-gallon molded polyethylene tank mounted on a steel frame with pressure feed inlet port on top with a 3/4" to 1-1/2" hose barb fitting, a discharge outlet port with 3/4" hose barb, a drain port with 1-1/2" PVC elbow at bottom of tank with manual or motorized valve to be connected to main drain line at rear of frame using 1-1/2" Schedule 40 PVC pipe or PVC hose, a control box with master switch. HEI model SST-500.

2.02 FILTERS

A. The drawings indicate diagrammatically the desired locations or arrangement of piping, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised

in executing the work to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions.

B. Solids Filter: 5-micron filter media with automatic index as a function of solids deposition, lower reservoir, stationary metal stands, gear motor pump (1/40 HP), control box, 3/4” inlet, 3/4” discharge and 3/4” drain. HEI model CMAFU-2.

C. Polishing Filtration System: dual polishing filtration system with two separate high-rate granular media polishing loops (Hydrosorb and Activated Carbon) for contaminant recovery, including emulsified oils, hydrocarbons, metals, trace chemicals, organics and bacteria. System includes 210-gallon oil coalescing tank, oil skimmer (powered internally), two 210-gallon process tanks, circulation pumps for process loops, hydrosorb media filter vessel, carbon media filter vessel, makeup water solenoid valve (10 GPM at 25 to 75 psi), control panel, HEI model HE/8000.

2.03 PUMPS

A. Provide pumps to meet the flow requirements of the vehicle wash system.

B. Cold Water Cannon: trigger operated system, 25 GPM at 500 psi through a variable spray nozzle, a Remote Equip-ment Module (REM) with a 100-feet hose on retract hose reel mounted to REM pedestal. HEI model Hydroblaster 25/500E.

C. High-Pressure Hot Water Wash System: water cannon coupled with an electric water heater, trigger operated system, 5 GPM at 3000 psi through a variable spray nozzle, a Remote Equipment Module (REM) with a 100-feet high-pressure hose on retract hose reel mounted to REM pedestal. HEI model Hydroblaster 5/3000EE.

2.04 HEATERS

A. Provide electric water heaters to meet the requirements shown on the drawings. See electric water heater at High-Pressure Hot Water Wash System in 2.03.B.

PART 3 EXECUTION

3.01 GENERAL

A. Obtain and pay for all permits and inspections, including any independent testing required to verify standard compliance, and deliver certificates for same to the Contracting Agency.

3.02 WORK RESPONSIBILITIES

A. The drawings indicate diagrammatically the desired locations or arrangement of piping, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions.

B. The Contractor is responsible for the correct placing of Work and the proper location and connection of Work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.

C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without extra cost, providing the change is ordered before the ductwork, piping, etc. and work directly connected to same is installed and no extra materials are required.

D. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.

E. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.

F. Should any changes to the Work indicated on the Drawings or described in the Specifications be necessary in order to comply with the above requirements, notify the Contracting Agency immediately and cease work on all parts of the contract, which are affected until approval for any required modifications to the construction has been obtained from the Contracting Agency.

G. Be responsible for any cooperative work, which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the Contracting Agency and shall be made to his satisfaction. Perform all Work with competent and skilled personnel.

H. All work, including aesthetic as well as mechanical aspects of the Work, shall be of the highest quality consistent with the best practices of the trade.

I. Replace or repair, without additional compensation, any work, which, in the opinion of the Contracting Agency, does not comply with these requirements.

END OF SECTION 22 70 00

SECTION 23 00 00
GENERAL MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE

A. Basic mechanical requirements specifically applicable to Division 23 and 33 Sections.

B. Work includes but is not necessarily limited to the following:
   1. Labor, materials, services, equipment, and appliances required for completion of tasks as indicated on drawing or in specification or as inherently necessary to prepare spaces and systems for new installations as follows:
      a. Heating, ventilating and air conditioning systems and equipment
      b. Steam piping systems and equipment
      c. Testing, adjusting and balancing

1.02 DRAWINGS AND SPECIFICATIONS

A. Drawings accompanying these Specifications show intent of Work to be done. Specifications shall identify quality and grade of installation and where equipment and hardware is not particularly specified, Contractor shall provide submittals for all products and install them per manufacturers' recommendations, and in a workmanlike manner.

B. Examine Drawings and Specifications for elements in connection with this Work; determine existing and new general construction conditions and be familiar with all limitations caused by such conditions.

C. Plans are intended to show general arrangement and extent of Work contemplated. Exact location and arrangement of parts shall be determined after the Contracting Agency has reviewed equipment, as Work progresses, to conform in best possible manner with surroundings, and as directed by the Contracting Agency.

D. Contract Documents are in part diagrammatic and intended to show the scope and general arrangement of the Work under this Contract. The Contractor shall follow these drawings in laying out the equipment, piping and ductwork. Drawings are not intended to be scaled for roughing in measurements or to serve as shop drawings. Where job conditions require minor changes or adjustments in the indicated locations or arrangement of the Work, such changes shall be made without change in the Contract amount.

E. Follow dimensions without regard to scale. Where no figures or notations are given, the Plans shall be followed.

1.03 UTILITIES

A. Location and sizes of electrical, mechanical and plumbing service facilities are shown in accordance with data secured from existing record drawings and site observations. Data shown are offered as an estimating guide without guarantee of accuracy. Check and verify all data given, and verify exact location of all utility services pertaining to Work prior to excavation or performing Work.

1.04 APPLICABLE REFERENCE STANDARDS, CODES AND REGULATIONS

A. Meet requirements of all state codes having jurisdiction.

B. State of Washington Code of Regulations:
   1. 2018 International Building Code (IBC)
   2. Current National Electric Code (NEC)
   3. 2018 International Mechanical Code
   4. 2018 Uniform Plumbing Code
   5. 2018 Washington State Energy Code
   6. 2018 International Fire Code

C. Additional Referenced Standards:
   1. AABC Associated Air Balance Council
   2. AMCA Air Moving and Conditioning Association

3. AHRI Air-Conditioning, Heating and Refrigeration Institute
4. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
5. ASME American Society of Mechanical Engineers
6. ASTM American Society for Testing and Materials
7. NEMA National Electrical Manufacturer's Association
8. NFPA National Fire Protection Association Standards
9. PDI Plumbing and Drainage Institute
10. UL Underwriters Laboratories

D. Codes and ordinances having jurisdiction over Work are minimum requirements; but, if Contract Documents indicate requirements, which are in excess of those minimum requirements, then requirements of the Contract Documents shall be followed. Should there be any conflicts between Contract Documents or codes or any ordinances having jurisdiction, report these to the Contracting Agency.

E. Obtain permits, and request inspections from authority having jurisdiction.

1.05 PROJECT AND SITE CONDITIONS

A. The arrangement of and connection to equipment shown on the Drawings is based upon information available and is not intended to show exact dimensions peculiar to a specific manufacturer. The Drawings are, in part, diagrammatic and some features of the illustrated equipment installations may require revision to meet actual equipment installation requirements. Structural supports, housekeeping pads, piping connections and adjacent equipment may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions or alterations.

B. Examine all Drawings and Specifications to be fully cognizant of all work required under this Division.

C. Examine site related work and surfaces before starting work of any Section.

D. Install Work in locations shown on approved Drawings, unless prevented by Project conditions.

E. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission from the Contracting Agency before proceeding.

1.06 COOPERATION WITH WORK UNDER OTHER DIVISIONS

A. Cooperate with other trades to facilitate general progress of Work. Allow all other trades every reasonable opportunity for installation of their work.

B. Work under this Division shall follow general building construction closely. Set pipe sleeves and inserts and verify that openings for chases and pipes are provided.

C. Work with other trades in determining exact location of outlets, pipes, and pieces of equipment to avoid interference with lines required to maintain proper installation of Work.

D. Make such progress in the Work to not delay work of other trades.

E. Mechanical Work shall have precedence over the other in the following sequence:
1. Soil and waste piping
2. Hydronic piping
3. Ductwork
4. Domestic water piping
5. Fire sprinkler piping

1.07 DISCREPANCIES

A. The Contractor shall check all Drawings furnished him immediately upon their receipt and shall promptly notify the Contracting Agency of any discrepancies. Figures marked on Drawings shall in general be followed in preference to scale measurements. Piping and instrumentation diagrams shall in general govern floor plans and sections. Large-scale drawings shall in general govern small-scale drawings.

B. Where requirements between Drawings and Specifications conflict, the more restrictive provisions shall apply.

C. If any part of the Specifications or Drawings appears unclear or contradictory, apply to Contracting Agency for interpretation and decision as early as possible, including during bidding period. Do not proceed with such work without Contracting Agency Representatives decision. Beginning work of any Section constitutes acceptance of conditions.

1.08 CHANGES

A. The Contractor shall be responsible to make and obtain approval from the Contracting Agency for all necessary adjustments in piping and equipment layouts as required to accommodate the relocations of equipment and/or devices, which are affected by any approved authorized changes or Product substitutions. All changes shall be clearly indicated on the "Record" drawings.

1.09 SUBMITTALS

A. Refer to Section 1-06 for additional requirements.

B. The manufacturer, contractor or supplier shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of that particular specification section.

C. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section.

D. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

E. Note that prior to acceptance of submittals for review, a submittal schedule shall be submitted to the Contracting Agency.

F. Submit all Division 23 shop drawings and product data grouped and referenced by the specification technical section number in one complete submittal package.

G. Shop Drawings:
   1. Include installation details of equipment indicating proposed location, layout and arrangement, accessories, piping, and other items that must be shown to assure a coordinated installation.
   2. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
   3. If equipment is rejected, revise drawings to show acceptable equipment and resubmit.

H. Whenever more than one (1) manufacturer’s product is specified, the first named product is the basis of design used in the Drawings and the use of alternate-named manufacturer’s products or substitutes may require modifications to the design.

I. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Contracting Agency bearing the Contracting Agency stamp of "Reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the Contracting Agency without additional compensation.

J. Manufacturer's Data: For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, certified equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.

K. Standard Compliance: When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or UL, submit proof of such conformance to the Contracting Agency Representative for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the Contracting Agency Representative. The certificate

shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.

L. Certified Test Reports: Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.

M. Certificates of Compliance or Conformance: Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this Contract. Pre-printed certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; or "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance or conformance.

1.10 PROJECT RECORD DOCUMENTS

A. Refer to Division 1-05.5(2) for additional requirements.
   1. All changes, deviations and information recorded on the “Project Record Drawings” set during Construction shall be marked on the “Project Record Drawings,” in red ink.

1.11 PRODUCT ALTERNATIVES OR SUBSTITUTIONS

A. Refer to General Conditions and Division 01 for additional requirements.

1.12 OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel.

1.13 MANUFACTURER S RECOMMENDATIONS

A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

1.14 DELIVERY AND STORAGE

A. Refer to Division 01 for additional requirements.

B. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B P, Appendix I, titled "Equipment Storage and Maintenance During Construction." Replace damaged or defective items with new items.

1.15 GUARANTEE

A. Except as may be specified under other sections in the Specifications, guarantee all equipment furnished under the Specifications for a period of one year from date of project acceptance against defective workmanship and material and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the Contracting Agency.

B. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Contracting Agency for their service agency as directed.

PART 2 PRODUCTS

A. Not Applicable.

PART 3 EXECUTION

3.01 GENERAL

A. Obtain and pay for all permits and inspections, including any independent testing required to verify standard compliance, and deliver certificates for same to the Contracting Agency.

3.02 WORK RESPONSIBILITIES

A. The drawings indicate diagrammatically the desired locations or arrangement of piping, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions.

B. The Contractor is responsible for the correct placing of Work and the proper location and connection of Work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.

C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without extra cost, providing the change is ordered before the ductwork, piping, etc. and work directly connected to same is installed and no extra materials are required.

D. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.

E. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.

F. Should any changes to the Work indicated on the Drawings or described in the Specifications be necessary in order to comply with the above requirements, notify the Contracting Agency immediately and cease work on all parts of the contract, which are affected until approval for any required modifications to the construction has been obtained from the Contracting Agency.

G. Be responsible for any cooperative work, which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the Contracting Agency and shall be made to his satisfaction. Perform all Work with competent and skilled personnel.

H. All work, including aesthetic as well as mechanical aspects of the Work, shall be of the highest quality consistent with the best practices of the trade.

I. Replace or repair, without additional compensation, any Work, which, in the opinion of the Contracting Agency, does not comply with these requirements.

3.03 PAINTING

A. Refer to Section 09 90 00 "Painting and Coating" for additional requirements.

B. Factory Applied:
   1. Mechanical equipment shall have factory-applied painting systems, which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.
   2. Refer to individual sections of this Division for more stringent requirements.

C. Field Applied:
   1. Paint all mechanical equipment as required to touch up, to match finish on other equipment in adjacent spaces or to meet safety criteria.
   2. Paint all exposed, uninsulated mechanical piping, valves, supports, hangers and appurtenances. Provide minimum 5 mils dry film thickness.
   3. Paint ductwork flat black that are visible behind air outlets and inlets.
   4. Paint all exposed and rooftop ductwork, roof mounted mechanical equipment, ductwork supports, hangers and appurtenances.

5. Paint shall be a high performance polyurethane enamel coating system.
   a. Acceptable paint manufacturers include Ameron, Tnemec or engineer approved equal.
   b. Acceptable primer manufacturers include Ameron Amershield VOC, Tnemec's Series 1075 (1074) Endura-Shield, semi-gloss (gloss) sheen or equal.
   c. Provide minimum 5 mils dry film thickness.

END OF SECTION 23 00 00

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 23 00 00 General Mechanical Requirements

1.02 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.03 QUALITY ASSURANCE

A. Bearings: Bearing loads and bearing life shall be determined using AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings, and AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

D. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

E. Motor Efficiency: Motors one horsepower and larger shall exceed current NEMA Premium Efficiency standards.

F. Structural Seismic Performance: Refer to Division 23 Section “Vibration and Seismic Controls for HVAC.”

1.04 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

1.05 SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each motor, provide operating weights; and manufacturer's technical data on specified features, performance, electrical ratings, and characteristics. Motor performance; percent efficiency, power factor, torque, RPM, power (W) and current vs. percent of rated power output (Horsepower) curves.

C. Operation and maintenance manual for the motor and installed devices.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
   1. U.S. Motors.
   2. General Electric.
   3. Siemens Motors.
   4. Baldor - Reliance.
   5. Westinghouse.
   6. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.02 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

2.03 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.04 SINGLE-PHASE MOTORS

A. Motor shall be an electronic commutation (EC) motor specifically designed for HVAC applications. AC induction type motors are not acceptable.

B. Motors shall be ECM, variable-speed, DC, brushless motors specifically designed for use with single phase, 60 hertz electrical input as shown on Drawings. Motor shall be complete with and operated by a single-phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commutate the stator. All motors shall be designed for synchronous rotation.

C. Motor rotor shall be permanent magnet type with near zero rotor losses. Motor shall have built-in soft start and soft speed change ramps.

D. Motor shall be able to be mounted with shaft in horizontal or vertical orientation.

E. Motor shall be permanently lubricated with ball bearings.

F. Motor shall maintain a minimum of 70% efficiency over its entire operating range.

G. Provide manual (or optional remote) fan speed output control as indicated on Drawings for field adjustment of motor speed. Inductors shall be provided to minimize harmonic distortion and line noise.

H. Overload Protection:
   1. Automatic Speed Control: In the event of overheating or overloading, the motor electronics slow the motor to operate within its acceptable range.
   2. Thermal Overload: Internally fused, one-shot type as a last resort to prevent fires.
   3. Locked Rotor: If the motor sees a locked rotor condition, it will automatically shut itself down, then try to restart 3 times. After the 3rd try, the motor will not attempt to restart until the power is cycled.

2.05 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Enclosure: Totally enclosed fan-cooled (TEFC), cast-iron (may use steel mounting base on 140-T frame series). IEC Protection: IP-44.

E. VFD Compatibility: “Inverter Ready” per NEMA Standard MG1, Part 31.4.4.2.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Insulation: Class F or H insulation, with Class B temperature rise, non-hygroscopic.
   3. Shaft Grounding Kit to reduce current flow through bearings, which has damaged many motors on campus.

F. Variable torque Ratio: 10:1 minimum.

G. Rotor Balance Requirement: 0.08 Inches per second maximum vibration.

H. Bearings: Shielded antifriction bearings suitable for application specific radial and thrust loading.
   1. The manufacturer’s analysis, and selection, shall ensure bearings will have an L_{10} life of not less than 130,000 hours for direct-drive and not less than 40,000 hours for belt-drive.
   2. Bearing styles and types matching special loading requirements. Over-sized bearings as required.
   3. Ensure motor bearings conform to requirements for Variable Frequency Drive applications.

I. Mounting Feet: Cast-iron precision machined flatness for accurate motor base mounting alignment per NEMA MG1.
   1. Foot-to-foot flatness from mounting hole to mounting hole shall not exceed 0.005 inches.

J. Conduit Boxes: Shall be over-sized NEMA, gasketed, repositionable box for field conduit routing adjustment, with grounding connection.

K. Lifting Lugs: For frame sizes 215 and above, permanent lifting provisions, such as eye bolts, shall be provided.

2.06 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Outdoor Applications: For outdoor applications provide “rain-proof” motors with options listed below Outdoor motor features listed below offer better environmental enclosure protection, and are in “addition to the required features” of protected indoor motors:
   1. IEC Ingress Protection Rating: IP-54.
   2. Epoxy paint on enclosure and rotor.
   3. Shaft slingers.
   4. Stainless steel nameplate and hardware.

B. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

C. Motors Used with Variable Frequency Controllers:
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
   5. Shaft Grounding Kit to reduce current flow through bearings.

D. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.07 SHAFT GROUNDING RINGS

A. Manufacturers:
   1. Electro Static Technology Inc. - Aegis SGR product line.
   2. Inpro/Seal, a division of Waukesha Bearings Corporation - CDR product line.

3. Or equal.

B. Provide shaft grounding rings (SGRs) on 3-phase motors 1/2 hp or larger intended for used with variable-frequency drives (VFDs). The SGRs may be furnished by the motor manufacturer as an integral part of the motor, furnished factory-installed by the equipment manufacturer, or furnished for field installation by the equipment installer.

C. Description: Circumferential micro-fiber ring with metal frame, designed to conduct VFD induced bearing currents from the motor shaft to ground. Provides protection recommended in NEMA MG 1. Provide with mounting kit including bolts and bracket, or conductive epoxy to adhere to motor casing, to ensure ground connection from the SGR to the motor frame.

D. Provide SGRs on at least one end of the motor.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, maintenance clearances and other conditions affecting performance.

B. Examine roughing-in of conduit systems to verify actual locations of conduit connections before motor installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 MOTOR INSTALLATION

A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align motor with base. Align motors, bases, shafts, pulleys and belts with driven equipment, or couplers. Tension belts according to manufacturer's written instructions.

B. Comply with mounting and anchoring requirements specified in Division 23 Section "Vibration and Seismic Controls for HVAC."

C. Connect motor leads to power source using rings and bolts or split bolts as needed. Insulation of connected motor leads shall be of the highest quality and designed to withstand the same temperature as the internal windings. Ordinary electrical tape is not generally suitable for this service and shall not be used as the only means of insulation. Wire nuts are prohibited.

D. Motor power leads shall be marked at the source and at the connection box on the motor.

3.03 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
   2. Test interlocks and control features for proper operation.
   3. Verify that current in each phase is within nameplate rating.

B. Testing: Contracting Agency may engage a qualified testing agency to perform the following field quality-control testing:
   1. Perform each electrical test and visual and mechanical inspections stated in NETA ATS, Section 7.15.1 and certify compliance with test parameters.

C. After the Contracting Agency’s testing agency is finished, correct any malfunctioning units onsite, where possible, and retest to demonstrate compliance; otherwise, replace with new units and the University shall retest.

3.04 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 23 05 13

SECTION 23 05 17

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sleeves.

B. Stack-sleeve fittings.

C. Sleeve-seal systems.

D. Sleeve-seal fittings.

E. Grout.

F. Silicone sealants.

1.02 RELATED REQUIREMENTS

A. Section 07 84 13 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.03 RELATED DOCUMENTS

A. Section 23 00 00 General Mechanical Requirements

ACTION SUBMITTALS

B. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:

1. “No Exception Taken”.
2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

C. Product Data: For each type of product.

PART 2 PRODUCTS

2.01 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.02 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Thunderline Modular Seals; Link-Seal
2. Advance Products & Systems, Inc.
3. Calpico, Inc.
4. Metraflex Co.
5. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve. Designed to form a hydrostatic seal of 20-psig minimum.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel. Include two for each sealing element.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.
4. Link-Seal shall be basis of design.

2.03 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 SLEEVE INSTALLATION

A. Sleeves are not required for core-drilled holes, except where spill control is required

B. Install sleeves for pipes passing through interior concrete and masonry walls, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
b. Exception: Extend sleeves installed in floors for areas indicated 4 inches above finished floor level, including slabs on grade.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
a. Steel Pipe Sleeves: For mechanical rooms, and wet area applications where spill containment is required.
b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
c. Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
5. Where required, sleeve application and installation shall comply with UL approved Firestopping Detail.

C. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves.
2. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

D. Underground, Exterior-Wall Pipe Penetrations: Seal pipe penetrations using mechanical sleeve seals. Select penetration size to allow for 1-inch annular clear space between pipe and penetration for installing mechanical sleeve seals.
1. Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.02 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.03 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

END OF SECTION 23 05 17

This page intentionally left blank

SECTION 23 05 18
ESCUTCHEONS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Escutcheons.

B. Floor plates.

1.02 RELATED REQUIREMENTS

A. Section 23 00 00 General Mechanical Requirements

1.03 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. BrassCraft Manufacturing Co.; a Masco company.
   2. Keeney Manufacturing Company (The).
   3. Mid-America Fittings, Inc.

2.02 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; hinge; and spring-clip fasteners.

2.03 FLOOR PLATES

A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.

b. Chrome-Plated Piping: One-piece cast brass with polished, chrome-plated finish.
c. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
g. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
h. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.
i. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
j. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
k. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. New Piping: One-piece, floor plate.

3.02 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 23 05 18

SECTION 23 05 19

METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Thermometers.

B. Thermowells.

C. Dial-type pressure gauges.

D. Gauge attachments.

E. Test plugs.

F. Test-plug kits.

1.02 RELATED REQUIREMENTS

A. Section 23 21 13 “Hydronic Piping.”

B. Section 23 21 16 “Hydronic Piping Specialties.”

1.03 RELATED DOCUMENTS

A. Section 23 00 00 General Mechanical Requirements

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product indicated.

C. Schedule: For thermometers, pressure gauges, thermowell and test plugs indicating manufacturer's number, scale range, and location for each.

1.05 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gauge from manufacturer.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01 GENERAL

A. Select gauges such that the high limit of range does not exceed a factor of 1.5x the standard operating point for that particular system.

B. Select gauges so that system operating pressure is found within the middle 1/3 of overall range.

2.02 DIAL THERMOMETERS

A. Manufacturers
   1. Ashcroft Commercial Inc.
   2. Marsh Bellofram.
   3. Trerice, H. O. Co.
   4. Weiss Instruments, Inc.
   5. Weksler Instruments Inc.
   6. 3D Instruments.
   7. Or equal.

B. Bimetallic-Actuated
   1. Description: Adjustable angle, Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.200.
   2. Case: Highly polished, hermetically sealed, stainless steel, 5-inch diameter.
   3. Element: Bimetal coil.
   4. Dial: Satin-faced, or highly polished, non-reflective aluminum with permanently etched scale markings.
   5. Pointer: Black metal.
   6. Window: Double strength Glass.
   7. Ring: Stainless steel.
   8. Connector: Adjustable angle, NPT □ with ASME B1.1 screw threads.
   9. Stem: stainless steel, for thermo-well installation and of length to suit installation.
   10. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.
   11. Units: Scale shall be degrees Fahrenheit, unless otherwise indicated, suitable for the media operating temperatures.

2.03 THERMOWELLS

A. Manufacturers:
   1. Ashcroft Commercial Inc.
   2. Marsh Bellofram.
   3. Trerice, H. O. Co.
   4. Weiss Instruments, Inc.
   5. 3D Instruments
   6. Or equal.

B. Thermowells:
   1. Standard: ASME B40.200.
   2. Description: Pressure-tight, socket-type fitting made for insertion into piping.
   3. Pressure Rating: Not less than piping system design pressure.
   4. Material: stainless steel.
   5. Type: Stepped shank unless straight or tapered shank is indicated.
   6. External Threads: NPT 1/2, NPT 3/4, or NPT 1, ASME B1.20.1 pipe threads.
   7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
   8. Bore: Diameter required to match thermometer bulb or stem.
   9. Insertion Length: Extend one-third to two-thirds of pipe diameter into fluid.
   10. Lagging Extension: Extension for Insulated Piping: 2 inches nominal and not less than thickness of insulation.
   11. Bushings: are prohibited.

C. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.04 PRESSURE GAUGES

A. Manufacturers:
   1. Ashcroft Commercial Inc.
   2. Marsh Bellofram.
   3. Trerice, H. O. Co.
   4. Weiss Instruments, Inc.
   5. 3D Instruments.
   6. Or equal.

B. Direct-Mounting, Dial-Type Pressure Gauges: Indicating-dial type complying with ASME B40.100.
   1. Case: Liquid-fillable type, 4.5-inch diameter Grade-A phosphor Bronze or stainless steel.
   2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
   3. Pressure Connection: Brass, or stainless steel, NPT □, or □, bottom-outlet type unless back-outlet type is indicated.

4. Movement: Mechanical, direct drive or with link to pressure element and connection to pointer.
5. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.
6. Pointer: Black metal.
7. Window: Glass.
8. Ring: Stainless steel.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.
12. Scale: Scale shall be psig, inches mercury vacuum, combination of those two depending on the application.
13. Units: PSI only. Dual unit gauges (e.g. kPa and PSI) are prohibited.

2.05 GAUGE ATTACHMENTS

A. Snubbers: ASME B40.100, 303 stainless steel; with NPT 1/4 or NPA 1/2, ASME B1.20.1 pipe threads and surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of stainless-steel pipe with threaded ends.

C. Valves: NPT □ or □ stainless-steel threaded ball valve type.

2.06 TEST PLUGS

A. Manufacturers:
1. Peterson Equipment Co., Inc.
2. Sisco Manufacturing Co.
3. IMI Hydronic Engineering (Flow Design), Inc.
4. Or equal.

B. Description: Corrosion-resistant brass or stainless-steel body with minimum two core inserts and gasketed and threaded cap with cap retainer, with extended stem beyond insulation for units to be installed in insulated piping.

C. Thread Size: NPT 1/2, ASME B1.20.1 pipe thread.

D. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

E. Core Inserts: Two chlorosulfonated (CR) polyethylene synthetic and EPDM (Nordel) self-sealing rubber, valves gasketed orifice, suitable for inserting a 1/8” OD probe assembly.
1. Insert material for air, water (except for water heated by high temperature water), oil, or gas service at 20 to 200 deg F shall be CR.
2. Insert material for air or high temperature water heated hot water service at 30 to plus 275 deg F shall be EPDM.

F. If test plug requires probes longer than 1-inch, provide to the Contracting Agency three probes of the required length for the installed test plug.

2.07 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Peterson Equipment Co., Inc.
2. Sisco Manufacturing Co.
3. IMI Hydronic Engineering (Flow Design), Inc.
4. Or equal.

B. Furnish one test-plug kit containing two thermometers, one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

D. High-Range Thermometer: Small, bimetallic insertion type with 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

E. Pressure Gauge: Small, Bourdon-tube insertion type with 3-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig.

F. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 EXECUTION

3.01 THERMOMETER APPLICATIONS

A. Install bimetallic-actuated dial thermometers in the following locations:
   1. Inlet and outlet of each hydronic zone.
   2. Inlet and outlet of each hydronic steam generator.
   3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
   4. Inlet and outlet of each hydronic heat exchanger.

B. Subject to listed standard ranges from the approved manufacturer, provide the following temperature ranges for thermometers:
   1. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
   2. Condenser Water: 0 to 160 deg F, with 2-degree scale divisions.
   3. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.
   4. Steam and Condensate: 50 to 500 deg F, with 5-degree scale divisions.

3.02 GAUGE APPLICATIONS

A. Install dry-case-type pressure gauges for inlet and discharge of each pressure-reducing valve.

B. Install dry-case-type pressure gauges at chilled- and condenser-water inlets and outlets of chillers.

C. Install liquid-filled-case-type pressure gauges at suction and discharge of each pump.

D. Subject to listed standard ranges from the approved manufacturer, provide the following pressure ranges for the gauges:
   1. Heating Hot Water Piping: 0 to 200 psi.
   2. Condenser Water Piping: 0 to 100 psi.
   3. Chilled Water Piping: 0 to 200 psi.
   4. Steam Piping: 0 to 200 psi.

3.03 INSTALLATION

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending a minimum of 2 inches into fluid or to the center of pipe and in vertical position in piping tees where thermometers are indicated.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounting pressure gauges in piping tees with pressure gauge located on pipe at most readable position.

F. Install ball valve in piping for each pressure gauge for fluids (except steam). Install snubber fitting in piping for each pressure gauge for pumps.

G. Install □-inch forged steel globe valve and syphon fitting in piping for each pressure gauge for steam see campus standard detail.

H. Install test plugs in tees in piping.

I. Install sight flow indicators, in accessible positions for easy viewing, in piping systems.

J. Assemble and install connections, tubing, and accessories between flow-measuring elements as prescribed by manufacturer's written instructions.

K. Install permanent indicators on walls or brackets in accessible and readable positions.

L. Install connection fittings for attachment to portable indicators in accessible locations.

3.04 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance for meters, gauges, machines, and equipment.

3.05 ADJUSTING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gauges to proper angle for best visibility.

3.06 CLEANING

A. Clean windows of meters, and gauges, and factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer’s touch-up paint.

END OF SECTION 23 05 19

This page intentionally left blank

SECTION 23 05 23.12
BALL VALVES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bronze ball valves.

B. Steel ball valves.

1.02 RELATED DOCUMENTS

A. Section 23 00 00 General Mechanical Requirements

1.03 DEFINITIONS

A. CWP: Cold working pressure.

B. SWP: Steam working pressure.

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of valve.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, and weld ends.
   3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded-end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.5 for flanges on steel valves.
   4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   5. ASME B16.18 for solder-joint connections.
   6. ASME B31.1 for power piping valves.
   7. ASME B31.9 for building services piping valves.

C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

D. Refer to HVAC valve schedule articles for applications of valves.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:
   1. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:
   1. Include 2-inch stem extensions.
   2. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
   3. Memory stops that are fully adjustable after insulation is applied.

I. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE BALL VALVES

A. Bronze Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:
   1. Manufacturers:
      a. NIBCO Figure T-585-70-66 or T-585HP-66-LF (High Performance)
      b. Milwaukee Valve Figure BA400S.
      c. Conbraco Industries, Inc; Apollo Division Figure 77-140.
   2. Description:
      a. Standard: MSS SP-110.
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600-1000 psig.
      d. Body Design: Two piece.
      e. Body Material: Bronze.
      f. Ends: Threaded.
      g. Seats: PTFE.
      h. Stem: Stainless steel.
      i. Ball: Stainless steel, vented.
      j. Port: Full.

2.03 STEEL BALL VALVES

A. Steel Ball Valves with Full Port and Stainless-Steel Trim, Class 150:
   1. Manufacturers:
      a. NIBCO Figure F-515-CS-F-66-FS.
      b. Milwaukee Valve Figure F201CSN2.
      c. Conbraco Industries, Inc; Apollo Division Figure 6PLF.
   2. Description:
      a. Standard: MSS SP-72.
      b. CWP Rating: 285 psig.
      c. Body Design: Split body.
      d. Body Material: Carbon steel, ASTM A216, Type WCB.
      e. Ends: Flanged.
      f. Seats: Reinforced PTFE.
      g. Stem: 316 Stainless steel.
      h. Ball: 316 Stainless steel, vented.
      i. Port: Full.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

3.03 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

B. Select valves with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
   2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

3.04 VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Bronze ball valves, two-piece, with stainless-steel trim, extended stem or thermal insulating tee handle to allow vapor barrier piping insulation, full port, threaded or press connection-joint ends.

B. Pipe NPS 2-1/2 to NPS 4: Steel ball valves, Class 150, two-piece, with stainless-steel trim, extended stem or thermal insulating tee handle to allow vapor barrier piping insulation, full port, may be provided with threaded ends instead of flanged ends.

END OF SECTION 23 05 23.12

This page intentionally left blank

SECTION 23 05 23.14
CHECK VALVES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bronze swing check valves.

B. Iron, center-guided check valves.

1.02 RELATED DOCUMENTS

A. Section 23 00 00 General Mechanical Requirements

1.03 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. SWP: Steam working pressure.

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of valve.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded-end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   4. ASME B16.18 for solder joint.
   5. ASME B31.1 for power piping valves.
   6. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 150:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. NIBCO T-433-B.
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Milwaukee Valve Company.
      d. Conbraco Industries, Inc; Apollo Division
   2. Description:
      a. Standard: MSS SP-80, Type 3.
      b. CWP Rating: 300 psig.
      c. Body Design: Horizontal flow.
      d. Body Material: ASTM B 62, bronze.
      e. Ends: Threaded.
      f. Disc: Bronze.

2.03 IRON, CENTER-GUIDED CHECK VALVES

A. Iron, Globe, Center-Guided Check Valves with Resilient Seat, Class 125:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. NIBCO F-910-B-LF.
      b. Milwaukee Valve Company.
      c. Mueller Steam Specialty.
   2. Description:
      a. Standard: MSS SP-125.
      b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
      c. NPS 14 to NPS 24, CWP Rating: 150 psig.
      d. Body Material: ASTM A126, cast iron.
      e. Style: Globe, spring loaded.
      f. Ends: Flanged.
      g. Seat: EPDM.

B. Iron, Globe, Center-Guided Check Valves with Resilient Seat, Class 250:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. NIBCO F-960-B-LF.
      b. Milwaukee Valve Company.
      c. Mueller Steam Specialty.
   2. Description:
      a. Standard: MSS SP-125.
      b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
      c. NPS 14 to NPS 24, CWP Rating: 300 psig.
      d. Body Material: ASTM A126, cast iron.
      e. Style: Globe, spring loaded.
      f. Ends: Flanged.
      g. Seat: EPDM.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Center-Guided Check Valves: In horizontal or vertical position with upward flow, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

F. Install valve tags. Comply with requirements for valve tags and schedules in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.03 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Pump-Discharge Check Valves:
      a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
      b. NPS 2-1/2 and Larger: Iron globe, center-guided, resilient-seat check valves.

B. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
   3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
   4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
   5. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.05 CONDENSER-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Bronze swing check valves with bronze disc, Class 150.

B. Pipe NPS 2-1/2 and Larger: Iron, globe, center-guided check valves resilient seat, Class 125.

3.06 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Bronze swing check valves with bronze disc, Class 150.

B. Pipe NPS 2-1/2 and Larger: Iron, globe, center-guided check valves resilient seat, Class 125.

END OF SECTION 23 05 23.14

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal pipe hangers and supports.

B. Trapeze pipe hangers.

C. Fiberglass pipe hangers.

D. Metal framing systems.

E. Fiberglass strut systems.

F. Thermal-hanger shield inserts.

G. Fastener systems.

H. Pipe stands.

I. Equipment supports.

1.02 RELATED REQUIREMENTS

A. Retain Sections in subparagraphs below that contain requirements Contractor might expect to find in this Section but are specified in other Sections.

B. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

C. Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.

D. Section 23 05 48 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.

E. Section 23 31 13 "Metal Ducts" and Section 23 31 16 "Nonmetal Ducts" for duct hangers and supports.

1.03 RELATED DOCUMENTS

A. Section 23 00 00 “General Mechanical Requirements.”

1.04 REFERENCES

A. ASME B31.9 Building Services Piping

B. MSS SP58 Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application and installation

C. MSS SP-69 Pipe Hangers and Supports – Selection and Application

D. MSS SP-89 Pipe Hangers and Supports – Fabrication and Installation Practices

1.05 DEFINITIONS

A. ASCE: American Society of Civil Engineers

B. ASME: American Society of Mechanical Engineers

C. ASTM: America Society for Testing and Material

D. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

E. MFMA: Metal Framing Manufacturers Association

F. SEI: Structural Engineering Institute

1.06 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to Standard ASCE/SEI 7 – Minimum Design Loads for Buildings and Other Structures.
   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.07 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product indicated including component cut sheets and pre-approved details.

C. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
   1. Trapeze pipe hangers.
   2. Metal framing systems.
   3. Fiberglass strut systems.
   4. Pipe stands.
   5. Equipment supports.

D. Delegated Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of trapeze hangers.
   2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.08 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.09 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to current ASME Boiler and Pressure Vessel Code.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE 7.
   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.02 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
   3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
   2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel stainless steel.

2.03 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.04 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers:
   1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger material is fiberglass or fiberglass-reinforced resin.
   2. Hanger Rods: Continuous-thread rod, washer, and nuts made of fiberglass polyurethane or stainless steel.

B. Strap-Type, Fiberglass Pipe Hangers:
   1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger material is fiberglass-reinforced resin.
   2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.05 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
   1. Description: Shop or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
   2. Standard: MFMA-4.
   3. Channels: Continuous slotted steel channel with in-turned lips.
   4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
   5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
   6. Metallic Coating: Electroplated zinc, Mill galvanized, In-line, hot galvanized or Mechanically-deposited zinc.

B. Non-MFMA Manufacturer Metal Framing Systems:
   1. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.

C. Standard: Comply with MFMA-4.

D. Channels: Continuous slotted steel channel with in-turned lips.

E. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

F. Hanger Rods: Continuous-thread rod, nuts, and washer made of PVC coated carbon steel, hot dipped galvanized carbon steel or stainless steel.

G. FIBERGLASS STRUT SYSTEMS

I. Description: Shop or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.

J. Channels: Continuous slotted fiberglass or other plastic channel with in-turned lips.

K. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

L. Hanger Rods: Continuous-thread rod, nuts, and washer made of fiberglass stainless steel.

2.06 VERTICAL RISER CLAMPS FOR INSULATED PIPES

A. Vertical Riser Clamps for Insulated Steel Pipes:
   1. Manufacturer shall be Pipe Shields Inc. Model E2100 or equal.
   2. Carbon steel pipe material, steel straps and base that is compliance with ASTM A36.
   3. Insulation shall be calcium silicate, asbestos free, treated with water repellant.
   4. Jacket shall be galvanized steel that is in compliance with ASTM A-527.
   5. Fasteners shall comply with ASTM A-307 plated.
   6. Coating shall be primer coated.

B. Vertical Riser Clamps for Insulated Copper Pipes:
   1. Manufacturer shall be Hydra-Zorb Titan Riser Clamp or equal.
   2. 25/50 flame spread/smoke spread index.
   3. Eliminates insulation compression.
   4. Crush resistant.
   5. Vertical load rating up to 2400 lbs.

2.07 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers
   1. Pipe Shields Inc.
   2. Pittsburg Corning Foamglas ONE
   3. ITW Insulation Systems TRYMER 2000 XP

B. Cold Piping: Insulation-Insert Material - ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Hot Piping: Insulation-Insert Material - Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.08 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.09 PIPE STANDS

A. General Requirements for Pipe Stands: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:
   1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   2. Base: Stainless steel.
   3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
   4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:
   1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
   2. Bases: One or more; plastic.
   3. Vertical Members: Two or more protective-coated-steel channels.
   4. Horizontal Member: Protective-coated-steel channel.
   5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.10 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.11 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Non-staining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
   2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 07 72 00 "Roof Accessories" for curbs.

I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

N. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

P. Insulated Piping:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and corrosion-resistant attachments for hostile environment applications.

G. Copper Pipe or Tubing
   1. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
   2. Or use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
   7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
   11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
   12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
   13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
   14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
   15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
   16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
   17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
   18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
   19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
   20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
   21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of non-insulated pipe risers NPS 3/4 to NPS 24.
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of non-insulated pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
   3. Insulated piping shall use vertical riser clamps for insulated pipe.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment, up to 6 inches for heavy loads.
   2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
   3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
   4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
   5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
   3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
   5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
   6. C-Clamps (MSS Type 23): For structural shapes.
   7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
   8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
   9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
   10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
   11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
   12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
      a. Light (MSS Type 31): 750 lb.
      b. Medium (MSS Type 32): 1500 lb.
      c. Heavy (MSS Type 33): 3000 lb.
   13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
   14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
   15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
   2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
   3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
   4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
   5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
   6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
   7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
   8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
      a. Horizontal (MSS Type 54): Mounted horizontally.
      b. Vertical (MSS Type 55): Mounted vertically.
      c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29

SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Elastomeric isolation pads.
B. Elastomeric isolation mounts.
C. Restrained elastomeric isolation mounts.
D. Open-spring isolators.
E. Housed-spring isolators.
F. Restrained-spring isolators.
G. Housed-restrained-spring isolators.
H. Pipe-riser resilient supports.
I. Resilient pipe guides.
J. Air-spring isolators.
K. Restrained-air-spring isolators.
L. Elastomeric hangers.
M. Spring hangers.
N. Snubbers.
O. Restraint channel bracings.
P. Restraint cables.
Q. Seismic-restraint accessories.
R. Mechanical anchor bolts.
S. Adhesive anchor bolts.
T. Vibration isolation equipment bases.
U. Restrained isolation roof-curb rails.

1.02 RELATED REQUIREMENTS

A. Section 21 05 48 "Vibration and Seismic Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
B. Section 22 05 48 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.

1.03 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.04 DEFINITIONS

A. IBC: International Building Code.
B. ICC-ES: ICC-Evaluation Service.
C. OSHPD: Office of Statewide Health Planning & Development.

1.05 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.

2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of an agency acceptable to authorities having jurisdiction.
      b. Annotate to indicate application of each product submitted and compliance with requirements.
   3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

C. Shop Drawings:
   1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

D. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
   1. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic forces required to select vibration isolators and seismic restraints and for designing vibration isolation bases.
      a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
   3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
   4. Seismic-Restraint Details:
      a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
      b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
      c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
      d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.

E. Field quality-control reports.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPM number from OSHPD, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
   1. Contractor shall consult on requirements with Structural Engineer of Record or other acceptable qualified engineer by the authority having jurisdiction.

2.02 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads.
   1. Manufacturer and Model:
      a. Basis of Design:
         1) Mason Industries Type MBSW.
      b. Or Approved Equal by:
         1) California Dynamics Corporation.
         2) Kinetics Noise Control.
         3) Vibrex.
         4) Isotech Industries.
   2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
   3. Size: Factory or field cut to match requirements of supported equipment.
   4. Pad Material: Oil and water resistant with elastomeric properties.
   5. Surface Pattern: Waffle pattern.
   6. Load-bearing metal plates adhered to pads.
   7. Sandwich-Core Material: Resilient and elastomeric

2.03 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts.
   1. Manufacturer and Model:
      a. Basis of Design:
         1) Mason Industries Type ND.
      b. Or Approved Equal by:
         1) California Dynamics Corporation.
         2) Kinetics Noise Control.
         3) Vibrex.

4) Isotech Industries.

2. Mounting Plates:
   a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
   b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.04 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts.
   1. Manufacturer and Model:
      a. Basis of Design:
         1) Mason Industries Type BR.
      b. Or Approved Equal by:
         1) California Dynamics Corporation.
         2) Kinetics Noise Control.
         3) Vibrex.
         4) Isotech Industries.
   2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
      a. Housing: Cast-ductile iron or welded steel.
      b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.05 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators.
   1. Manufacturer and Model:
      a. Basis of Design:
         1) Mason Industries Type SLFH.
      b. Or Approved Equal by:
         1) California Dynamics Corporation.
         2) Kinetics Noise Control.
         3) Vibrex.
         4) Isotech Industries.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
   7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.06 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing.
   1. Manufacturer and Model:
      a. Basis of Design:
         1) Mason Industries Type C.
      b. Or Approved Equal by:
         1) California Dynamics Corporation.
         2) Kinetics Noise Control.
         3) Vibrex.
         4) Isotech Industries.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
    a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Top housing with attachment and leveling bolt, threaded mounting holes and internal leveling device.

2.07 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint.
1. Manufacturer and Model:
    a. Basis of Design:
        1) Mason Industries Type SLR.
    b. Or Approved Equal by:
        1) California Dynamics Corporation.
        2) Kinetics Noise Control.
        3) Vibrex.
        4) Isotech Industries.
2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
    a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Top plate with threaded mounting holes and elastomeric pad.
    c. Internal leveling bolt that acts as blocking during installation.
3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.08 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing.
1. Manufacturer and Model:
    a. Basis of Design:
        1) Mason Industries Type SSLFH.
    b. Or Approved Equal by:
        1) California Dynamics Corporation.
        2) Kinetics Noise Control.
        3) Vibrex.
        4) Isotech Industries.
2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
    a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.09 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
   1. Manufacturer and Model:
      a. Basis of Design:
         1) Mason Industries Type SSLFH.
      b. Or Approved Equal by:
         1) California Dynamics Corporation.
         2) Kinetics Noise Control.
         3) Vibrex.
         4) Isotech Industries.
   2. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
   3. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.10 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
   1. Manufacturer and Model:
      a. Basis of Design:
         1) Mason Industries Type ADA.
      b. Or Approved Equal by:
         1) California Dynamics Corporation.
         2) Kinetics Noise Control.
         3) Vibrex.
         4) Isotech Industries.
   2. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.11 AIR-SPRING ISOLATORS

A. Freestanding, Single or Multiple, Compressed-Air Bellows.
   1. Manufacturer and Model:
      a. Basis of Design:
         1) Mason Industries Type MT.
      b. Or Approved Equal by:
         1) California Dynamics Corporation.
         2) Kinetics Noise Control.
         3) Vibrex.
         4) Isotech Industries.
   2. Bellows Assembly: Upper and lower powder-coated steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows or similar elastomeric material.
   3. Maximum Natural Frequency: 3 Hz.
   4. Operating Pressure Range: 25 to 100 psig.
   5. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
   6. Tank valves.

2.12 RESTRAINED-AIR-SPRING ISOLATORS

A. Freestanding, Single or Multiple, Compressed-Air Bellows with Vertical-Limit Stop Restraint.
   1. Manufacturer and Model:
      a. Basis of Design:
         1) Mason Industries Type SLR-MT.
      b. Or Approved Equal by:
         1) California Dynamics Corporation.
         2) Kinetics Noise Control.
         3) Vibrex.
         4) Isotech Industries.
   2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
      a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
      b. Top plate with threaded mounting holes elastomeric pad.
      c. Internal leveling bolt that acts as blocking during installation.
   3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
   4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   8. Bellows Assembly: Upper and lower powder-coated steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows or similar elastomeric material.
   9. Maximum Natural Frequency: 3 Hz.
   10. Operating Pressure Range: 25 to 100 psig.
   11. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
   12. Tank valves.

2.13 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods.
   1. Manufacturer and Model:
      a. Basis of Design:
         1) Mason Industries Type HD.
      b. Or Approved Equal by:
         1) California Dynamics Corporation.
         2) Kinetics Noise Control.
         3) Vibrex.
         4) Isotech Industries.
   2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
   3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.14 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression.
   1. Manufacturer and Model:
      a. Basis of Design:
         1) Mason Industries Type 30N OR PC30NS.
      b. Or Approved Equal by:
         1) California Dynamics Corporation.
         2) Kinetics Noise Control.

3) Vibrex.
4) Isotech Industries.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.15 SNUBBERS

A. Manufacturer and Model:
   1. Basis of Design:
      a. Mason Industries Type Z-1011.
   2. Or Approved Equal by:
      a. California Dynamics Corporation.
      b. Kinetics Noise Control.
      c. Vibrex.
      d. Isotech Industries.

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
   1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
   2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
   3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

2.16 RESTRAINT CHANNEL BRACINGS

A. Manufacturer and Model:
   1. Basis of Design:
      a. Mason Industries Type Seismic Sway Bracing System.
   2. Or Approved Equal by:
      a. California Dynamics Corporation.
      b. Kinetics Noise Control.
      c. Vibrex.
      d. Isotech Industries.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.17 RESTRAINT CABLES

A. Manufacturer and Model:
   1. Basis of Design:
      a. Mason Industries Type SCBA Assembly, SCR, UC & CCB.
   2. Or Approved Equal by:
      a. California Dynamics Corporation.
      b. Kinetics Noise Control.

c. Vibrex.
d. Isotech Industries.

B. Restraint Cables: ASTM A 603 galvanized ASTM A 492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.18 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturer and Model:
1. Basis of Design:
a. Mason Industries Type SCR, UC & CCB.
2. Or Approved Equal by:
a. California Dynamics Corporation.
b. Kinetics Noise Control.
c. Vibrex.
d. Isotech Industries.

B. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.19 MECHANICAL ANCHOR BOLTS

A. Manufacturer and Model:
1. Basis of Design:
a. Mason Industries Type SAB/SAS.
2. Or Approved Equal by:
a. California Dynamics Corporation.
b. Kinetics Noise Control.
c. Hilti.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.20 ADHESIVE ANCHOR BOLTS

A. Manufacturer and Model:
1. Basis of Design:
a. Mason Industries Type SAA.
2. Or Approved Equal by:
a. California Dynamics Corporation.
b. Kinetics Noise Control.
c. Hilti.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.21 VIBRATION ISOLATION EQUIPMENT BASES

A. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Manufacturer and Model:
   a. Basis of Design:
      1) Mason Industries Type RND Rails.
   b. Or Approved Equal by:
      1) California Dynamics Corporation.
      2) Kinetics Noise Control.
      3) Vibrex.
      4) Isotech Industries.
2. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
   a. Include supports for suction and discharge elbows for pumps.
3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
4. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
1. Manufacturer and Model:
   a. Basis of Design:
      1) Mason Industries Type MSL.
   b. Or Approved Equal by:
      1) California Dynamics Corporation.
      2) Kinetics Noise Control.
      3) Vibrex.
      4) Isotech Industries.
2. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
   a. Include supports for suction and discharge elbows for pumps.
3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
4. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Manufacturer and Model:
   a. Basis of Design:
      1) Mason Industries Type BMK.
   b. Or Approved Equal by:
      1) California Dynamics Corporation.
      2) Kinetics Noise Control.
      3) Vibrex.
      4) Isotech Industries.
2. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
   a. Include supports for suction and discharge elbows for pumps.
3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
4. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
5. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.22 RESTRAINED SEISMICALLY ISOLATION ROOF-CURB RAILS

A. Manufacturer:
   1. Basis of Design:
      a. Mason Industries.
   2. Or Approved Equal by:
      a. California Dynamis Corporation.
      b. Kinetics Noise Control.
      c. Vibrex.
      d. Isotech Industries.

B. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic forces.

C. Upper Frame: The upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic forces.

D. Lower Support Assembly: The lower support assembly shall be formed sheet metal section containing adjustable and removable steel springs that support the upper frame. The lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly. Adjustable, restrained-spring isolators shall be mounted on elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.

F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

D. Piping Restraints:
1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

E. Install cables so they do not bend across edges of adjacent equipment or building structure.

F. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

J. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 23 21 13 "Hydronic Piping" for piping flexible connections.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Contracting Agency, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Structural Engineer of Record.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. Test and adjust restrained-air-spring isolator controls and safeties.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.06 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.07 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete."

END OF SECTION 23 05 48

This page intentionally left blank

SECTION 23 05 49
VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Separately enclosed, pre-assembled, combination variable frequency drives (VFD), rated 600 V and less, solid-state, PWM, for speed control of poly-phase, squirrel-cage induction motors.

1.02 RELATED REQUIREMENTS

A. Section 23 05 13 “Common Motor Requirements for HVAC Equipment

B. Section 23 05 48 “Vibration and Supports for HVAC”

C. Section 23 08 00 “Commissioning of HVAC”

1.03 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

DEFINITIONS

B. Factory-Installed VFD: A VFD installed by motorized-equipment manufacturer as a component of equipment.

C. Field-Installed VFD: A VFD installed at project site. VFDs shipped with motorized-equipment but installed at project site shall be considered Field-Installed VFDs.

D. Legend:
   1. BAS: Building Automation System.
   2. EMI: Electromagnetic Interface.
   3. IBC: International Building Code.
   4. ICC-ES: ICC-Evaluation Service.
   5. IGBT: Insulated-Gate Bipolar Transistor.
   6. LAN: Local Area Network.
   7. LED: Light-Emitting Diode.
   8. MCP: Motor-Circuit Protector.
   9. NC: Normally Closed.
   10. NO: Normally Open.
   11. OCPD: Overcurrent Protective Device.
   12. OSHPD: Office of Statewide Health Planning & Development (for the State of California).
   13. PID: Control Action, Proportional Plus Integral Plus Derivative.
   14. PWM: Pulse-Width Modulation.
   15. TDD: Total Demand (harmonic current) Distortion.
   16. THD(V): Total Harmonic Voltage Demand.
   17. VFD: Variable Frequency Drive.

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data for each type of VFD
   1. For each type and rating of VFD indicated, include features, performance, electrical ratings, operating characteristics, location of wiring terminations, conduit entry and ground lug locations, shipping and operating weights, and furnished specialties and accessories.

C. Shop Drawings
   1. For each VFD indicated, include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
   2. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Each installed VFD's type and details.
      b. Factory-installed devices.
      c. Enclosure types and details.
      d. Nameplate legends.
      e. Short-circuit current (withstand) rating of enclosure unit.
      f. Features, characteristics, ratings, and factory settings of each VFD and installed devices.
      g. Specified Modifications.
   3. Schematic and Connection Wiring Diagrams for power, signal, and control wiring.

D. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFDs where pipe and ducts are prohibited. Show VFD layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

E. Manufacturer Seismic Qualification Certification: Submit certification that VFDs, accessories, and components will withstand seismic forces defined in Section 23 05 48 "Vibration and Supports for HVAC." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Qualification Data: For manufacturer and testing agency.

G. Test Report: Field quality-control test reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance data: For VFDs to include in emergency, operation, and maintenance manuals.
   1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
   2. Manufacturer's written instructions for setting field-adjustable overload relays.
   3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
   4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Power Fuses: equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   2. Control Power Fuses: equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualification: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Electrical Components, Devices, and Accessories: listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Source Limitations: Obtain factory and field-installed VFD's of a single type through one source from a single manufacturer.

D. VFD's and options shall be UL listed as a complete assembly. The base VFD shall be UL listed for 100 KAIC without the need for input fuses.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver VFD's in shipping splits of lengths that can be moved past obstructions in delivery path.

B. Store VFDs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFDs from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. If stored in space that is not permanently enclosed and air conditioned
1. Cover VFDs to protect them from weather, dirt, dust, corrosive substances, and physical damage.
2. Remove loose packing and flammable materials from inside controllers.
3. Install electric heating of sufficient wattage to prevent condensation.

1.09 PROJECT CONDITIONS

A. Environmental/Service Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:
1. Ambient temperature, 32 to 105°F.
2. Ambient Storage Temperature: Not less than minus 4°F and not exceeding 140°F.
3. 0% to 95% relative humidity, non-condensing.
4. Elevation: Not exceeding 3,300 feet without derating.
5. AC line voltage variation, -15% to +10% of nominal.

B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by the Contracting Agency or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
1. Notify the Contracting Agency no fewer than three weeks in advance of proposed interruption of electrical systems.
2. Indicate method of providing temporary electrical service.
3. Do not proceed with interruption of electrical systems with the Contracting Agency's written permission.
4. Comply with NFPA-70E.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFDs, including clearances between VFDS, and adjacent surfaces and other items.

1.10 COORDINATION

A. Coordinate the features of motors, load characteristics, installed units, and accessory devices of each VFD to be compatible with the following:
1. Torque, speed, and horsepower requirements of the load.
2. Designed and labeled for use with each motor throughout speed range without overheating
3. Ratings and characteristics of supply circuit and required control sequence.

4. Ambient and environmental conditions of installation location.

B. Coordinate layout and installation of VFDs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

D. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

E. Provide comprehensive commission of mechanical systems in accordance with Division 23 Section 23 08 00 "Commissioning of HVAC" and as specified elsewhere in these Specifications. This includes cooperation and assistance with the Commissioning Authority to provide fully commissioned systems. Review the commissioning requirements of the project and provide support as required.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of start-up.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB.

B. Danfoss.

C. Yaskawa.

2.02 GENERAL

A. VFD's serving mechanical equipment shall be provided from one manufacturer.

B. Furnish complete variable frequency drives as specified herein for the equipment designated as variable speed.
   1. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified.
   2. Include inlet air filters.
   3. Interior VFD enclosure shall be ventilated and have UL/NEMA Type 12 rating, unless otherwise specified.
   4. Exterior VFD enclosure shall be ventilated and have UL/NEMA Type 3R rating, unless otherwise specified.VFD enclosure shall be ventilated and have UL/NEMA Type 3R rating, unless otherwise specified.

C. The VFD shall convert three-phase, 60 Hz utility power to adjustable voltage and frequency, three-phase power for stepless motor speed control from 10% to 100% of the motor's 60 Hz speed. Input voltage shall be as specified on the drawing schedules.

D. The VFD shall include a converter and an inverter section. The converter section shall convert fixed frequency and voltage AC utility power to DC voltage. The inverter section of the VFD shall invert the DC voltage into a quality output waveform, with adjustable voltage and frequency for stepless motor speed control. The VFD shall maintain a constant V/Hz ratio

E. The VFD and options shall be tested to ANSI/UL Standard 508. The complete drive, including all specified options, shall be UL or ETL listed.

F. Power line noise shall be limited to a voltage distortion factor and line notch depth as defined in IEEE Standard 519-2014, IEEE Recommended Practice and Requirements for Harmonic Control in Electrical Power Systems. The total voltage distortion shall not exceed 5% at the point of common coupling.

G. PWM type drives shall include EMI/RFI filters that meet EN61800-3 for First Environment restricted level.

H. Motor noise as a result of the VFD shall be limited to three dB across the line operation, measured at three feet from the motor's center line.

I. The VFD's full load amp rating shall meet or exceed NEC Table 430-150.

J. Protective Features:
   1. Individual motor overload protection for each motor controlled.
   2. Protection against input power undervoltage, overvoltage, and phase loss.
   3. Protection against output current overload and instantaneous over current.
   4. Protection against exceeding temperature limits within VFD enclosure.
   5. Protection against overvoltage on the DC bus.
   6. Protect VFD from sustained power or phase loss. Undervoltage trip activates automatically when line voltage drops more than 10% below rated input voltage.
   7. Automatically reset faults due to undervoltage, overvoltage, phase loss, or exceeding temperature limits.
   8. Protection against output short circuit and motor winding shorting to case faults, as defined by UL 508.
   9. Status lights or digital display for indication of individual fault conditions.
   10. Controller capable of operating without a motor or any other equipment connected to the drive output to facilitate start-up and troubleshooting.
   11. The VFD shall have a dual 5% impedance DC link reactor on the positive and negative rails of the DC buss to minimize power line harmonics and protect the VFD from power line transients.
      a. The chokes shall be non-saturating. Swinging chokes that do not provide full harmonic filtering throughout the entire range are not acceptable.
      b. VFDs with saturating (non-linear) DC link reactors shall require an additional 3% AC line reactor to provide acceptable harmonic performance at full load, where harmonic performance is most critical.

K. Interface Features
   1. Door mounted or digital Hand/Off/Auto selector switch to start and stop the VFD. In the AUTO position, the VFD will start/stop from a remote contact closure. In the HAND position, the VFD will run regardless of the remote contact position.
   2. Manual speed control capability.
   3. Local selector switch: Motor speed is determined by the manual or digital speed control.
   4. Power/On light to indicate that the VFD is receiving utility power.
   5. Fault light to indicate that the VFD has tripped on a fault condition.
   6. Digital meter with selector switch to indicate percent speed and percent load.
   7. A set of form-C, dry contacts to indicate when the VFD is in the run mode.
   8. A set of form-C, dry contacts to indicate when the VFD is in the fault mode.
   9. A 0-10VDC or 4020 mA output signal to vary in direct proportion to the controller's speed.
   10. VFD to have terminal strip to accept N.C. safety contacts. VFD to safety shut down in drive or by-pass mode when contacts open.
   11. VFD to accept an additional N.C. contact to interface with the Hand/Off/Auto switch for remote Stop/Start control.
   12. VFD shall accept an external 0-10 VDC or 4-20 mA speed control signal.
   13. VFD shall have Proportional Integral Derivative (PID) loop control for VFD operation and independent PID loop control for Contracting Agency use.

L. Adjustments
   1. Maximum speed, adjustable 50-100% base speed.
   2. Minimum speed, adjustable 0-50% base speed.
   3. Acceleration time, adjustable 3-60 seconds.
   4. Deceleration times, adjustable 3-60 seconds with override circuit to prevent nuisance trips if deceleration time is set too short.
   5. Current limit, adjustable 0-105%.
   6. Overload trip set point.
   7. Offset and gain to condition the input speed signal.

M. Special Features
   1. The following special features shall be included in the VFD enclosure:
      a. VFD shall include a communication port with standard protocols (BACnet/Modbus/N2) to match Contracting Agency DDC system. Coordinate with DDC manufacturer to provide a seamless interface between the VFD and DDC system.
      b. All panels shall be marked for 100,000 AMP short circuit current rating in compliance with UL.
      c. Provide a manual door interlocked main fused disconnect switch, pad lockable in the off position.
   2. All power and low voltage terminations into and out of VFD on NEMA 3R enclosures shall be through the bottom of drive cabinet through factory provided knock-outs.
   3. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 130% of rated torque for up to 2 seconds while starting. The VFD shall provide full motor torque at any selected frequency from 20 Hz to based speed while providing a variable torque V/Hz output at reduced speed. Breakaway torque of 140% shall be available.
   4. The VFD shall include current sensors on all output phases.
   5. The VFD shall continue to operate with reduced output without faulting with input voltage as low as 85% of the nominal voltage and shall provide full rated output for input voltages of 90% of nominal.
   6. The VFD shall have a minimum of Class 20 I2t motor overload protection, which shall automatically compensate for changes in motor speed.
   7. All VFDs shall have the same interchangeable customer interface keypad to allow a single programmable keypad to download information to multiple VFDs during startup procedures.
   8. The VFD shall accept up to two feedback signals, each with independent scaling.
   9. None of the above features shall affect the UL or ETL listing of the unit.

2.03 PERFORMANCE REQUIREMENTS

A. Seismic Performance: VFDs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFDs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.
   1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.04 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.

B. Output Filtering: Supply Dv/Dt on motor lead lengths over 75 feet.

C. CE Mark – The base drive shall conform to the European Union Electromagnetic Compatibility directive, a requirement for CE marking. The base drive shall meet product standard EN 61800-3 for the First Environment restricted distribution (Category C2).

2.05 BYPASS SYSTEMS

A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

B. Bypass Mode: Manual operation only; requires local operator selection at VFD. Transfer between power converter and bypass contactor, and retransfer shall only be allowed with the motor at zero speed.

C. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic-control system feedback.

D. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter input and output and permit safe testing and troubleshooting of the power converter, both energized and de-energized, while motor is operating in bypass mode.
   1. Bypass Contactor: Load-break, IEC rated contactor.
   2. Input and Output Isolating Contactors: Non-load-break, IEC rated contactors.
   3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

E. Bypass Contactor Configuration: Full voltage across the line for applications 75 HP and below. Solid State reduced voltage starting for motors 75 HP and above.
   1. NORMAL/BYPASS selector switch.
   2. HAND/OFF/AUTO selector switch.
   3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFD while the motor is running in the bypass mode.
   4. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
      a. Operating Voltage: Depending on contactor IEC size and line-voltage rating, manufacturer's standard matching control power or line voltage.
      b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
   5. Control Circuits: 120 V ac; obtained from integral CPT, with primary and secondary fuses with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices. Retain "CPT Spare Capacity" Subparagraph below if retaining "CPT" option in "Control Circuits" Subparagraph above and spare CPT capacity is required. Spare capacity is normally available in 100-VA increments. Consult manufacturers for maximum spare capacity and for available CPT sizes for different NEMA and enclosure sizes, because adding spare capacity and an oversized CPT may require using an enlarged enclosure.
   6. Overload Relays: NEMA ICS 2.
      a. Melting-Alloy Overload Relays:
         1) Inverse-time-current characteristic.
         2) Selectable Class 10, 20 and 30 tripping characteristic.
         3) Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
      b. Bimetallic Overload Relays:
         1) Inverse-time-current characteristic.
         2) Selectable Class 10, 20 and 30 tripping characteristic.
         3) Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
         4) Ambient compensated.
         5) Automatic resetting.
      c. Solid-State Overload Relays:
         1) Switch or dial selectable for motor-running overload protection.
         2) Sensors in each phase.
         3) Class 10 and 20 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
         4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
         5) Analog communication module.
      d. NC and NO isolated overload alarm contact.
      e. External overload, reset push button.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide factory mounting brackets and attachments for VFDs. Field modification or drilling of enclosures is not permitted. Mounting brackets and supports shall not block required access and clearances for VFD.

3.02 START-UP AND COMMISSIONING SERVICE

A. The manufacturer shall provide start-up commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer's site. Sales personnel and other agents who are not factory certified technicians for drive field repairs shall not be acceptable as commissioning agents. Coordinate commissioning requirements with the Commissioning Authority as specified under Section 23 08 00 "Commissioning of HVAC."

B. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system. Included in this service shall be (as a minimum):
   1. Verification of contractor wire terminations to the VFD and its optional circuitry.
   2. Installation verification for proper operation and reliability of the VFD, the motor being drive, and the building automation system.
   3. Conform to training requirements specified elsewhere. In addition, the VFD manufacturer's certified trainer shall provide up to one-hour of customer operator training on operation and service diagnostics at the time of the equipment commissioning.
   4. Measurements for verification of proper operation on each of the following items:
      a. Motor voltage and frequency. Verification of proper motor operation.
      b. Control input for proper building automation system interface and control calibration.
      c. Calibration check for the following setpoints (and adjustments as necessary):
         1) minimum speed.
         2) maximum speed.
         3) acceleration rate.
         4) deceleration rate.
      d. VFD manufacturer technician shall document all default and custom drive settings.
   5. Submit Start-Up and Commissioning Reports.

3.03 EXAMINATION

A. Contractor shall coordinate with Manufacturer/Supplier to verify that jobsite meets factory recommended and code required conditions for proper VFD installation prior to the installation. Additionally, contractor shall address Manufacturer/Supplier's recommendations to assure proper installation prior to the installation. Manufacturer/Supplier shall visit jobsite subsequent to the installation to verity VFD's are installed properly. Items considered shall include (at a minimum):
   1. Clearance spacing
   2. Temperature, contamination, dust, and moisture of the environment.
   3. Separate conduit installation of the motor wiring, power wiring, and control wiring.
   4. Installation per the manufacturer's recommendation.
   5. Measure voltage rise, time, and magnitude.
   6. Cover and protect the VFD from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.
   7. VFD input and output power shall be installed in separate conduits.

END OF SECTION 23 05 49

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment labels.

B. Warning signs and labels.

C. Pipe labels.

D. Duct labels.

E. Stencils.

F. Valve tags.

G. Warning tags.

1.02 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.

C. Samples: For color, letter style, and graphic representation required for each identification material and device.

D. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.04 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 GENERAL

A. Manufacturers:
   1. Craftmark Identification Systems.
   2. Seton Identification Products.
   3. MSI Marking Services.
   4. Setmark.

2.02 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: Brass or anodized aluminum, 0.032-inch minimum thickness and having predrilled or stamped holes for attachment hardware.
   2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or contact-type permanent adhesive, compatible with label and substrate.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
1. Material and Thickness: Three-layer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick and having predrilled holes for attachment hardware.
2. Color Coding:
   a. Letter Color: White.
   b. Background Color: Red.
3. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless-steel rivets or contact-type permanent adhesive, compatible with label and substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.03 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Color Coding:
1. Background Color: Yellow.
2. Letter Color: Black.

C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

F. Fasteners: Stainless-steel rivets or self-tapping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.04 PIPE LABELS

A. Do not use pipe labels or plastic tapes for bare pipes conveying fluids at temperatures of 125 deg F (52 deg C) or higher.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

C. Pre-tensioned Pipe Labels for Outside Diameter Less or Equal to 8 Inches: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels for Outside Diameter Greater than 8 Inches: Printed plastic with contact-type, permanent-adhesive backing. Either marker shall show accepted color-coded background, proper color of legend in relation to background color, accepted legend letter size, accepted marker length.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.05 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

F. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.06 STENCILS

A. Stencils for Piping: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of □ inch for access panel and door labels, equipment labels and similar operational instructions.
   1. Stencil Material: Brass
   2. Stencil Paint: Exterior, gloss, alkyd enamel, black unless otherwise indicated. Pain may be in pressurized spray-can form.
   3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

B. Stencils for Ducts:
   1. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances up to 15 feet and proportionately larger lettering for greater viewing distances.
   2. Stencil Material: Brass.
   3. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
   4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.

C. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
   1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
   2. Stencil Material: Brass
   3. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.

4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.

2.07 VALVE TAGS

A. Valve Tags: Stamped or engraved with □-inch letters for piping system abbreviation and □ inch sequenced numbers.
   1. Tag Material: Brass, 0.032-inch minimum thickness and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2 by 11 inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve tag schedule shall be included in operation and maintenance data.

2.08 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7 inches.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as “DANGER”, “CAUTION” or “DO NOT OPERATE.”
   4. Color:
      a. Background Color: Yellow.
      b. Letter Color: Black.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.03 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.04 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Section 09 91 23 "Interior Painting"

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Within one foot of each valve and control device.
   2. Near each branch connection and riser takeoff.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. Near major equipment items and other points of origination and termination.
   5. At access doors, manholes, and similar access points that permit view of concealed piping.
   6. Spaced at maximum intervals of 20 feet along each run, but not less than once in each room at entrance and exit of each concealed space.
   7. On piping above removable acoustical ceilings.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Pipe Label Color Schedule:
   1. Condenser-Water Piping:
      a. Background Color: Green.
      b. Letter Color: White.

3.05 DUCT LABEL INSTALLATION

A. Locate ductwork labels where ductwork is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Within one foot of each control device.
   2. Near each branch connection and riser takeoff.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. Near major equipment items and other points of origination and termination.
   5. Spaced at maximum intervals of 20 feet along each run, but not less than once in each room at entrance and exit of each concealed space.
   6. On ductwork above removable acoustical ceilings.

B. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
   1. Exhaust Air Ducts:
      a. Background Color: Yellow.
      b. Letter Color: Black.
   2. Supply Air, Return Air and Outside Air:
      a. Background Color: Blue.
      b. Letter Color: White
   3. Return Air and Outside Air:
      a. Background Color: Green.
      b. Letter Color: White
   4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

3.06 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except valves within factory-fabricated equipment units; faucets; convenience and lawn-watering hose connections. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
   1. Valve-Tag Size and Shape:
      a. Chilled Water: 2 inches, round.
      b. Condenser Water: 2 inches, round.
      c. Hot Water: 2 inches, round.
      d. Refrigerant: 2 inches, round.
      e. Gas: 2 inches, round.
      f. Steam: 2 inches, round.
   2. Valve-Tag Color:
      a. Chilled Water: Natural.
      b. Condenser Water: Natural.
      c. Hot Water: Natural.
      d. Refrigerant: Natural.
      e. Gas: Natural.
      f. Steam: Natural.
   3. Letter Color:
      a. Chilled Water: Black.
      b. Condenser Water: Black.

c. Hot Water: Black.
d. Refrigerant: Black.
e. Gas: Black.
f. Steam: Black.

C. All above and below grade and interior and exterior valves shall be tagged. Submit valve tag chart to the Contracting Agency Representative for review and approval at the completion of the project.

3.07 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 23 05 53

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Balancing Air Systems:
   1. Constant-volume air systems.
   2. Variable-air-volume systems.

B. Balancing Hydronic Piping Systems:
   1. Constant-flow hydronic systems.
   2. Variable-flow hydronic systems.
   3. Primary-secondary hydronic systems.

C. Testing, Adjusting, and Balancing Equipment:
   1. Motors.Cooling towers.
   2. Boilers.
   3. Heat-transfer coils.
   4. Pumps.

D. Sound tests.

E. Vibration tests.

F. Duct leakage tests.

G. Control system verification.

1.02 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.03 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

1.04 PREINSTALLATION MEETINGS

A. TAB Conference: Conduct a TAB conference at Project site with the Engineer and Commissioning Agent after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
   1. Minimum Agenda Items:
      a. The Contract Documents examination report.
      b. The TAB plan.
      c. Needs for coordination and cooperation of trades and subcontractors.
      d. Proposed procedures for documentation and communication flow.

1.05 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.

2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. TAB Report:
   1. Air-Balance Report for Prerequisite IEQ 1: Documentation indicating that work complies with ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
   2. TAB Report for Prerequisite EA 2: Documentation indicating that work complies with ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: Submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:
   1. Instrument type and make.
   2. Serial number.
   3. Application.
   4. Dates of use.
   5. Dates of calibration.

1.07 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Engage an independent TAB Contractor certified by AABC, NEBB or TABB.
   1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC, NEBB or TABB.
   2. TAB Technician: Employee of the TAB specialist and certified by AABC, NEBB or TABB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.08 FIELD CONDITIONS

A. Full Contracting Agency Occupancy: Contracting Agency will occupy the site and existing building during entire TAB period. Cooperate with Contracting Agency during TAB operations to minimize conflicts with Contracting Agency's operations.

B. Partial Contracting Agency Occupancy: Contracting Agency may occupy completed areas of building before Substantial Completion. Cooperate with Contracting Agency during TAB operations to minimize conflicts with Contracting Agency's operations.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves.
   1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
   2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

K. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

A. Prepare a TAB plan that includes the following:
   1. Equipment and systems to be tested.
   2. Strategies and step-by-step procedures for balancing the systems.
   3. Instrumentation to be used.
   4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
   1. Airside:
      a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
      b. Duct systems are complete with terminals installed.
      c. Volume, smoke, and fire dampers are open and functional.
      d. Clean filters are installed.
      e. Fans are operating, free of vibration, and rotating in correct direction.
      f. Variable-frequency controllers' startup is complete and safeties are verified.
      g. Automatic temperature-control systems are operational.
      h. Ceilings are installed.
      i. Windows and doors are installed.
      j. Suitable access to balancing devices and equipment is provided.
   2. Hydronics:
      a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
      b. Piping is complete with terminals installed.
      c. Water treatment is complete.
      d. Systems are flushed, filled, and air purged.
      e. Strainers are pulled and cleaned.
      f. Control valves are functioning per the sequence of operation.
      g. Shutoff and balance valves have been verified to be 100 percent open.
      h. Pumps are started and proper rotation is verified.
      i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
      j. Variable-frequency controllers' startup is complete and safeties are verified.
      k. Suitable access to balancing devices and equipment is provided.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE Standard 111 or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
   1. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 23 33 00 "Air Duct Accessories."
   2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 23 07 13 "Duct Insulation," Section 23 07 16 "HVAC Equipment Insulation," and Section 23 07 19 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 23 31 13 "Metal Ducts."

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure total airflow.
      a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
      b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
      c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
      d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
   2. Measure fan static pressures as follows:
      a. Measure static pressure directly at the fan outlet or through the flexible connection.
      b. Measure static pressure directly at the fan inlet or through the flexible connection.
      c. Measure static pressure across each component that makes up the air-handling system.
      d. Report artificial loading of filters at the time static pressures are measured.
   3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
   4. Obtain approval from Contracting Agency for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
   5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
   1. Measure airflow of submain and branch ducts.
   2. Adjust submain and branch duct volume dampers for specified airflow.
   3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.
   1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
   2. Measure inlets and outlets airflow.
   3. Adjust each inlet and outlet for specified airflow.
   4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.
   1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
   2. Re-measure and confirm that total airflow is within design.
   3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
   4. Mark all final settings.
   5. Test system in economizer mode. Verify proper operation and adjust if necessary.
   6. Measure and record all operating data.
   7. Record final fan-performance data.

3.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:
   1. Verify that the system static pressure sensor is located at least two-thirds of the distance down the duct from the fan discharge or as shown on the Drawings.
   2. Verify that the system is under static pressure control.
   3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
   4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
      a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
      b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
      c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
      d. Adjust controls so that terminal is calling for minimum airflow.
      e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
      f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
   5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
      a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
      b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
      c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
      d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
      e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
   6. Measure fan static pressures as follows:
      a. Measure static pressure directly at the fan outlet or through the flexible connection.
      b. Measure static pressure directly at the fan inlet or through the flexible connection.
      c. Measure static pressure across each component that makes up the air-handling system.
      d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
    b. Verify that terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:
    a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
    b. Re-measure and confirm that total airflow is within design.
    c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
    d. Mark final settings.
    e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
    f. Verify tracking between supply and return fans.
    g. Verify building pressurization control by measuring building pressure at various operating conditions.

3.07 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
    1. Check liquid level in expansion tank.
    2. Check highest vent for adequate pressure.
    3. Check flow-control valves for proper position.
    4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
    5. Verify that motor starters are equipped with properly sized thermal protection.
    6. Check that air has been purged from the system.

3.08 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.
    1. Measure total water flow.
        a. Position valves for full flow through coils.
        b. Measure flow by main flow meter, if installed.
        c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
    2. Measure pump TDH as follows:
        a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
        b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
        c. Convert pressure to head and correct for differences in gage heights.
        d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
        e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
    3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.
   1. Measure flow in main and branch pipes.
   2. Adjust main and branch balance valves for design flow.
   3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   1. Measure flow at terminals.
   2. Adjust each terminal to design flow.
   3. Re-measure each terminal after it is adjusted.
   4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
   5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:
   1. Measure differential pressure and verify that it is within manufacturer's specified range.
   2. Perform temperature tests after flows have been verified.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:
   1. Measure and balance coils by either coil pressure drop or by using P/T ports.
   2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. Verify final system conditions as follows:
   1. Re-measure and confirm that total water flow is within design.
   2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
   3. Mark final settings.

G. Verify that memory stops have been set.

3.09 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above in General Procedures for Hydronic Systems.

B. Adjust the variable-flow hydronic system as follows:
   1. Verify that the differential-pressure sensor is located as indicated.
   2. Determine whether there is diversity in the system.

C. For systems with no diversity:
   1. Adjust pumps to deliver total design gpm.
      a. Measure total water flow.
         1) Position valves for full flow through coils.
         2) Measure flow by main flow meter, if installed.
         3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
      b. Measure pump TDH as follows:
         1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
         2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
         3) Convert pressure to head and correct for differences in gage heights.
         4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
         5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
      c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
   2. Adjust flow-measuring devices installed in mains and branches to design water flows.
      a. Measure flow in main and branch pipes.

b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   a. Measure flow at terminals.
   b. Adjust each terminal to design flow.
   c. Re-measure each terminal after it is adjusted.
   d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
   e. Perform temperature tests after flows have been balanced.
4. For systems with pressure-independent valves at terminals:
   a. Measure differential pressure and verify that it is within manufacturer's specified range.
   b. Perform temperature tests after flows have been verified.
5. For systems without pressure-independent valves or flow-measuring devices at terminals:
   a. Measure and balance coils by either coil pressure drop or temperature method.
   b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
6. Prior to verifying final system conditions, determine the system differential-pressure set point.
7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
8. Mark final settings and verify that all memory stops have been set.
9. Verify final system conditions as follows:
   a. Re-measure and confirm that total water flow is within design.
   b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
   c. Mark final settings.
10. Verify that memory stops have been set.

D. For systems with diversity:
1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
3. Adjust pumps to deliver total design gpm.
   a. Measure total water flow.
      1) Position valves for full flow through coils.
      2) Measure flow by main flow meter, if installed.
      3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
   b. Measure pump TDH as follows:
      1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      3) Convert pressure to head and correct for differences in gage heights.
      4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
      5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
   c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
4. Adjust flow-measuring devices installed in mains and branches to design water flows.
   a. Measure flow in main and branch pipes.

b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   a. Measure flow at terminals.
   b. Adjust each terminal to design flow.
   c. Re-measure each terminal after it is adjusted.
   d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
   e. Perform temperature tests after flows have been balanced.
6. For systems with pressure-independent valves at terminals:
   a. Measure differential pressure, and verify that it is within manufacturer's specified range.
   b. Perform temperature tests after flows have been verified.
7. For systems without pressure-independent valves or flow-measuring devices at terminals:
   a. Measure and balance coils by either coil pressure drop or temperature method.
   b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
9. Prior to verifying final system conditions, determine system differential-pressure set point.
10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
11. Mark final settings and verify that memory stops have been set.
12. Verify final system conditions as follows:
    a. Re-measure and confirm that total water flow is within design.
    b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
    c. Mark final settings.
13. Verify that memory stops have been set.

3.10 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first.

B. Balance the secondary circuits after the primary circuits are complete.

C. Adjust pumps to deliver total design gpm.
   1. Measure total water flow.
      a. Position valves for full flow through coils.
      b. Measure flow by main flow meter, if installed.
      c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
   2. Measure pump TDH as follows:
      a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      c. Convert pressure to head and correct for differences in gage heights.
      d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
      e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
   3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

D. Adjust flow-measuring devices installed in mains and branches to design water flows.
   1. Measure flow in main and branch pipes.
   2. Adjust main and branch balance valves for design flow.
   3. Re-measure each main and branch after all have been adjusted.

E. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   1. Measure flow at terminals.
   2. Adjust each terminal to design flow.
   3. Re-measure each terminal after it is adjusted.
   4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
   5. Perform temperature tests after flows have been balanced.

F. For systems with pressure-independent valves at terminals:
   1. Measure differential pressure and verify that it is within manufacturer's specified range.
   2. Perform temperature tests after flows have been verified.

G. For systems without pressure-independent valves or flow-measuring devices at terminals:
   1. Measure and balance coils by either coil pressure drop or temperature method.
   2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

H. Verify final system conditions as follows:
   1. Re-measure and confirm that total water flow is within design.
   2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
   3. Mark final settings.

I. Verify that memory stops have been set.

3.11 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer's name, model number, and serial number.
   2. Motor horsepower rating.
   3. Motor rpm.
   4. Phase and hertz.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.
   7. Starter size and thermal-protection-element rating.
   8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.12 PROCEDURES FOR COOLING TOWERS

A. Balance total condenser-water flows to towers. Measure and record the following data:
   1. Condenser-water flow to each cell of the cooling tower.
   2. Entering- and leaving-water temperatures.
   3. Wet- and dry-bulb temperatures of entering air.
   4. Wet- and dry-bulb temperatures of leaving air.
   5. Condenser-water flow rate recirculating through the cooling tower.
   6. Cooling-tower spray pump discharge pressure.
   7. Condenser-water flow through bypass.
   8. Fan and motor operating data.

3.13 PROCEDURES FOR BOILERS

A. Hydronic Boilers:
   1. Measure and record entering- and leaving-water temperatures.
   2. Measure and record water flow.
   3. Record relief valve pressure setting.

B. Steam Boilers:
   1. Measure and record entering-water temperature.
   2. Measure and record feed water flow.
   3. Measure and record leaving-steam pressure and temperature.
   4. Record relief valve pressure setting.

3.14 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:
   1. Entering- and leaving-water temperature.
   2. Water flow rate.
   3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
   4. Dry-bulb temperature of entering and leaving air.
   5. Wet-bulb temperature of entering and leaving air for cooling coils.
   6. Airflow.

B. Measure, adjust, and record the following data for each electric heating coil:
   1. Nameplate data.
   2. Airflow.
   3. Entering- and leaving-air temperature at full load.
   4. Voltage and amperage input of each phase at full load.
   5. Calculated kilowatt at full load.
   6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:
   1. Dry-bulb temperature of entering and leaving air.
   2. Airflow.
   3. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:
   1. Dry-bulb temperature of entering and leaving air.
   2. Wet-bulb temperature of entering and leaving air.
   3. Airflow.

3.15 SOUND TESTS

A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels at locations as designated by the Architect.

B. Instrumentation:
   1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
   2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).
   3. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
   4. The accuracy of the sound-testing meter shall be plus or minus one decibel.

C. Test Procedures:
   1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
   2. Equipment should be operating at design values.
   3. Calibrate the sound-testing meter prior to taking measurements.
   4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
   5. Record a set of background measurements in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment off.
   6. Take sound readings in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment operating.

7. Take readings no closer than 36 inches from a wall or from the operating equipment and approximately 60 inches from the floor, with the meter held or mounted on a tripod.
8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.

D. Reporting:
1. Report shall record the following:
a. Location.
b. System tested.
c. dBA reading.
d. Sound pressure level in each octave band with equipment on and off.
2. Plot sound pressure levels on NC worksheet with equipment on and off.

3.16 VIBRATION TESTS

A. After systems are balanced and construction is Substantially Complete, measure and record vibration levels on equipment having motor horsepower equal to or greater than 25.

B. Instrumentation:
1. Use portable, battery-operated, and microprocessor-controlled vibration meter with or without a built-in printer.
2. The meter shall automatically identify engineering units, filter bandwidth, amplitude, and frequency scale values.
3. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.
4. Verify calibration date is current for vibration meter before taking readings.

C. Test Procedures:
1. To ensure accurate readings, verify that accelerometer has a clean, flat surface and is mounted properly.
2. With the unit running, set up vibration meter in a safe, secure location. Connect transducer to meter with proper cables. Hold magnetic tip of transducer on top of the bearing, and measure unit in mils of deflection. Record measurement, then move transducer to the side of the bearing and record in mils of deflection. Record an axial reading in mils of deflection by holding nonmagnetic, pointed transducer tip on end of shaft.
3. Change vibration meter to velocity (inches per second) measurements. Repeat and record above measurements.
4. Record CPM or rpm.
5. Read each bearing on motor, fan, and pump as required. Track and record vibration levels from rotating component through casing to base.

D. Reporting:
1. Report shall record location and the system tested.
2. Include horizontal-vertical-axial measurements for tests.
3. Verify that vibration limits follow Specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from the AABC National Standards. Acceptable levels of vibration are normally "smooth" to "good."
4. Include in report General Machinery Vibration Severity Chart, with conditions plotted.

3.17 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.18 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:
1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.

4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.19 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 percent or minus 0 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.20 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.21 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.

8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.
2. Motor Data:
    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.

d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Apparatus-Coil Test Reports:
1. Coil Data:
a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Motor Data:
a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.

e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

I. Air-Terminal-Device Reports:
1. Unit Data:
a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft.

2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data:
a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.

d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.
2. Test Data (Indicated and Actual Values):
a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

L. Instrument Calibration Reports:
1. Report Data:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.22 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of commissioning authority.

B. Commissioning authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:
   1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
   2. If the second final inspection also fails, Contracting Agency may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
   3. If the second verification also fails, Contracting Agency may contact AABC, NEBB or TABB Headquarters regarding the Performance Guaranty.

F. Prepare test and inspection reports.

3.23 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

This page intentionally left blank

SECTION 23 07 13
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating the following duct services:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed return located in unconditioned space.
   4. Indoor, exposed return located in unconditioned space.
   5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
   6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
   7. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
   8. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
   9. Outdoor, concealed supply and return.
   10. Outdoor, exposed supply and return.

1.02 RELATED REQUIREMENTS

A. Section 23 07 16 "HVAC Equipment Insulation."

B. Section 23 07 19 "HVAC Piping Insulation."

C. Section 23 31 13 "Metal Ducts" for duct liners.

1.03 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

C. Sustainable Design/LEED Submittals:
   1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
   3. Detail application of field-applied jackets.
   4. Detail application at linkages of control devices.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.08 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.09 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation; SoftTouch Duct Wrap
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Friendly Feel Duct Wrap.
      d. Owens Corning; SOFTR All-service Duct Wrap.

2.02 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller.
      c. Knauf Insulation.
   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   5. Color: White.

C. Vapor-Barrier Permeance: ASTM 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Childers Brand; H. B. Fuller Construction Products.; CP10
      b. Eagle Bridges - Marathon Industries.; 550
      c. Foster Brand; H. B. Fuller Construction Products.; 146-50
   2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
   3. Service Temperature Range: Minus 50 to plus 220 deg F.
   4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
   5. Color: White.

2.03 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.; CP-76.
      b. Foster Brand; H. B. Fuller Construction Products.; 95-44.
      c. Mon-Eco Industries, Inc.; 44-05
      d. Eagle Bridges – Marathon Industries; 405.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: 20 to plus 250 deg F.
   5. Color: Aluminum.
   6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   7. Use sealants that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.04 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers.

b. ITW Insulation Systems; Illinois Tool Works, Inc.
c. RPR Products, Inc.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
      2) ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
      3) RPR Products, Inc.; Insul-Mate.
3. Factory cut and rolled to size.
4. Finish and thickness are indicated in field-applied jacket schedules.
   a. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
   b. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.

2.05 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Compac Corporation; 110 and 111.
      b. ABI, Ideal Tape Division; 491 AWF FSK.
      c. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
      d. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   2. Width: 3 inches.
   3. Thickness: 6.5 mils.
   4. Adhesion: 90 ounces force/inch in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.06 SECUREMENTS

A. Bands:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ITW Insulation Systems; Illinois Tool Works, Inc.; Gerrard Strapping and Seals.
      b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
   2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.
   3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
   4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
      a. Midwest Fasteners or approved equal.
      b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
      c. Spindle: Zinc-coated, low-carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
      d. Adhesive-backed base with a peel-off protective cover.
   5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

B. Wire: 0.062-inch soft-annealed, stainless steel.
   1. Manufacturers: Subject to compliance with requirements, provide product by:

a. C & F Wire, or equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
   1. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

E. Insulation Installation at Floor Penetrations:
   1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.05 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
   2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
   3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
      a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not over compress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Overlap un-faced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.06 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.07 FINISHES

A. Insulation with ASJ, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in 09 90 00 "Painting and Coating."
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
      a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.08 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air in unconditioned space.
   3. Indoor, concealed return located in unconditioned space.
   4. Indoor, exposed return located in unconditioned space.
   5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
   6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
   7. Outdoor, concealed supply and return.
   8. Outdoor, exposed supply and return.

B. Items Not Insulated:
   1. Metal ducts with duct liner of sufficient thickness to comply with WA State energy code.
   2. Metal ducts located in conditioned spaces.
   3. Factory-insulated flexible ducts.
   4. Factory-insulated plenums and casings.
   5. Flexible connectors.
   6. Vibration-control devices.
   7. Factory-insulated access panels and doors.

3.09 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Supply and return air duct and plenum insulation shall be the following:
   1. Mineral-Fiber Blanket: 1.5 inches thick and 0.75-lb/cu. ft. nominal density.

3.10 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Supply and return air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

3.11 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
   1. Aluminum, Smooth: 0.024 inch thick.

C. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
   1. Aluminum, Smooth with 2-1/2-Inch- Deep Corrugations 0.040 inch thick.

END OF SECTION 23 07 13

SECTION 23 07 16
HVAC EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. insulating the following HVAC equipment that is not factory insulated:
   1. Heat exchangers.
   2. Chilled-water pumps.
   3. Heating hot-water pumps.
   4. Chilled-water tanks.
   5. Heating, hot-water tanks.
   6. Chilled-water air separators.
   7. Heating hot-water air separators.

1.02 RELATED REQUIREMENTS

A. Section 23 07 13 "Duct Insulation."

B. Section 23 07 19 "HVAC Piping Insulation."

1.03 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance, thickness, and jackets (both factory and field-applied, if any).

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail removable insulation at equipment connections.
   3. Detail application of field-applied jackets.
   4. Detail application at linkages of control devices.
   5. Detail field application for each equipment type.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.08 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with equipment Installer for equipment insulation application.

1.09 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in "Equipment Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Cellular Glass:
   1. Description: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article. Comply with ASTM C 552.
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Pittsburgh Corning Corporation; Foamglas
      b. Specialty Products & Insulation (SPI)
      c. Or approved equal.
   3. Material Properties
      a. Thermal Conductivity: 0.31 BTU-in/(h-°F-ft2) max. at 75 °F
      b. Service Temperature Range: -450 °F to 800 °F
      c. Density: 6.1 to 8.6 lb/ft3
      d. Absorption of Moisture: 0.2% by Vol max.
      e. Water Vapor Permeability: 0.05 per in, max.
      f. Compressive Strength: 60 psi, min.
      g. Flexural Strength: 41 psi, min.
   4. Block Insulation: ASTM C 552, Type I.
   5. Special-Shaped Insulation: ASTM C 552, Type III.
   6. Board Insulation: ASTM C 552, Type IV.
   7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

F. Flexible Elastomeric Insulation:
   1. Description: Closed-cell. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Armacell LLC.
      b. Aeroflex USA, Inc.
      c. K-Flex USA.
      d. Or approved equal.
   3. Material Properties
      a. Thermal Conductivity: 0.28 BTU-in/(h-°F-ft2) max. at 75 °F
      b. Service Temperature Range: -290 °F to 250 °F
      c. Density: 3.0 to 6.0 lb/ft3
      d. Absorption of Moisture: 0.2% by Vol max.
      e. Water Vapor Permeability: 0.05 per in, max.

G. Mineral-Fiber Blanket Insulation
   1. Description: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied foil-scrim-kraft (FSK) jacket.
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Duct Wrap.
      d. Manson Insulation Inc.; Alley Wrap.
      e. Owens Corning; All-Service Duct Wrap.
      f. Or equal.

H. Mineral-Fiber Board Insulation
   1. Description: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation without factory-applied jacket if needed for building up thicknesses of insulation otherwise provide with factory-applied ASJ or with factory-applied FSK jacket.
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; Commercial Board.
      b. Fibrex Insulations Inc.; FBX.
      c. Johns Manville; 800 Series Spin-Glas.
      d. Knauf Insulation; Insulation Board.
      e. Manson Insulation Inc.; AK Board.
      f. Owens Corning; Fiberglas 700 Series.
      g. Or equal.

I. Phenolic:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Resolco Inc. Insul-Phen Green.
      b. Kingspan Tarec Industrial Insulation NV; Koolphen K.
   2. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
   3. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
   4. Factory-Applied Jacket: all service jacket (ASJ).
   5. Minimum of 5lb/ft3 density.
   6. Minimum 95% closed cell content.
   7. Maximum of 0.21 Btu-in/hr-ft2-F Thermal Conductivity at 50F.

2.02 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Adhesives shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Design Polymerics
      b. Foster Products Corporation
      c. Or equal.

D. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA, Inc.; Aeroseal.
      b. Armacell LLC; Armaflex 520 Adhesive.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
      d. K-Flex USA; R-373 Contact Adhesive.
      e. Or approved equal.

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand.
      b. Foster Brand.

F. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand.
      b. Foster Brand.

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Mastics shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168. Mastics shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Foster Brand.
      b. Knauf Insulation.
      c. Vimasco Corporation.
   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   5. Color: White.

2.05 SEALANTS

A. Joint Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.

2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.06 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Johns Manville; Zeston.
b. Proto Corporation; LoSmoke.
c. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White
4. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Brand
b. ITW Insulation Systems
c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
a. Sheet and roll stock ready for shop or field sizing.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:
1) Same material, finish, and thickness as jacket.
2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.07 SECUREMENTS

A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following:
a. ITW Insulation Systems

b. RPR Products, Inc.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, 3/4 inch wide with wing seal.

B. Wire: 0.062-inch soft-annealed, stainless steel.

1. Products: Subject to compliance with requirements, provide one of the following:

a. C&F Wire.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches on center.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches on center.
4. For below ambient services, apply vapor-barrier mastic over staples.
5. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.04 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Mineral-Fiber, Blanket Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    d. Do not over-compress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel bands.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery

of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.

7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive. Seal longitudinal seams and end joints.

3.05 INSTALLATION OF PHENOLIC INSULATION

A. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.

B. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

3.06 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.07 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials list shall be submitted to Engineer of Record for review.

B. Insulate indoor and outdoor equipment that is not factory insulated.
1. Mineral-Fiber Pipe and Tank: 1 inch thick.
2. Phenolic: 1 inch thick.

C. Condenser-water pump insulation shall be one of the following:
1. Cellular Glass: 3 inches thick.
2. Flexible Elastomeric: 1 inch thick.
3. Phenolic: 2 inches thick.

D. Heating-hot-water pump insulation shall be one of the following:
   1. Cellular Glass: 3 inches thick.
   2. Flexible Elastomeric: 2 inch thick.
   3. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

E. Tank insulation, up to 200 deg F, shall be one of the following:
   1. Cellular Glass: 2 inches thick.
   2. Mineral-Fiber Board: 1 inch thick and 2-lb/cu. ft. nominal density.
   3. Mineral-Fiber Pipe and Tank: 1 inch thick.

3.08 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Equipment, Concealed: None.

C. Equipment, Exposed:
   1. PVC, Color-Coded by System: 20 mils thick.
   2. Painted Aluminum, Stucco Embossed: 0.020 inch thick if exposed to damage.

3.09 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Equipment, Concealed: None.

C. Equipment, Exposed:
   1. Painted Aluminum, Stucco Embossed with Z-Shaped Locking Seam: 0.032 inch thick.

END OF SECTION 23 07 16

This page intentionally left blank

SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating the following HVAC piping systems:
   1. Condensate drain piping.
   2. Heating hot-water piping.

1.02 RELATED REQUIREMENTS

A. Section 23 07 13 "Duct Insulation."

B. Section 23 07 16 "HVAC Equipment Insulation."

C. Section 23 21 13.13 "Underground Hydronic Piping" for pre-insulated pipe insulation in underground piping outside the building.

1.03 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance, thickness, and jackets (both factory and field applied, if any). Clearly mark the materials being provided and its intended use of each product

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports if requested by the Contracting Agency.

1.06 QUALITY ASSURANCE

A. Insulation materials shall be manufactured at facilities certified and registered with an approved registrar to conform to the ISO 9001 Quality Standard.

B. All work shall conform to accepted industry and trade standards for commercial and industrial insulations and shall conform with manufacturer’s recommendations.

C. Installation shall be by licensed applicators.

D. Insulation materials that have become wet or contaminated shall not be installed.

E. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

F. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials (insulation, coverings, tapes, cements, adhesives, coatings, etc.) to the jobsite in factory containers with manufacturer's label showing manufacturer, product name and product hazard information.

B. Insulation shall be delivered to the job site in original, unopened manufacturer's containers.

C. Insulation shall be stored in a dry location and kept dry throughout construction. Wet or damaged insulation shall be removed and replaced by the Contractor at no additional cost.

1.08 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Systems."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.09 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

A. Products shall not contain CFC, asbestos, lead, mercury, or mercury compounds.

B. Insulation shall meet fire and smoke hazard ratings as tested under procedure ASTM E-84, NFPA 255, and UL 723 and shall not exceed flame spread rating of 25 and maximum smoke developed rating of 50.

C. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville's Micro-Lok *HP* all-service (ASJ) vapor-retarder jacket with a self-sealing longitudinal closure lap (SSL) and butt strips.
      b. Owens Corning; ASJ Fiberglas Pipe Insulation.
   2. Preformed mineral fiber pipe insulation with factory applied all-service vapor-retarder jacket (ASJ) jacket with a self-sealing longitudinal closure lap (SSL) and butt strips or approved alternate to seal butt joints. Preformed mineral fiber pipe insulation shall conform to ASTM C547. The ASJ facing shall conform to ASTM C1136 Type I.
   3. Preformed mineral fiber pipe insulation with factory applied all-service vapor-retarder jacket (ASJ) jacket shall have a flame spread rating not greater than 25 and a smoke developed rating not greater than 50 when tested as in accordance with ASTM E84, UL 723.
   4. Thermal conductivity (k-value): 0.23 Btu-in/hr-ft^2-°F at 75°F

5. Preformed mineral fiber pipe insulation shall have a water vapor sorption of less than 5% by weight as tested in accordance ASTM C 547.
6. All service jacket (ASJ) shall have a water vapor permeance of 0.02 perms or less as tested in accordance to ASTM E96, procedure “A”.
7. When a vapor mastic is required, a water vapor permeance of 0.02 per ASTM E-96 Procedure B must be achieved.
8. All accessory materials such as field installed jackets, mastics, coatings, tapes, fasteners shall be recommended by each component manufacturer for the specified application or as listed in the NAIMA Guide to Insulating Chilled Water Systems with Mineral Fiber Pipe Insulation.
9. Fittings, valves, tees, etc. shall be insulated with fiberglass insulation inserts covered with white PVC insulated fitting covers.

2.02 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated. Adhesives shall contain no flammable solvents if that option is available.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Design Polymerics DP 2590-CA
      b. ITW TACC, Division of Illinois Tool Works; SP80, T1080
      c. Marathon Industries, Inc.
   2. For indoor applications use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Design Polymerics DD2590-CA.
      b. ITW TACC, Division of Illinois Tool Works; SP80, T1080
      c. Marathon Industries, Inc.
   2. For indoor applications use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.03 MASTICS

A. Materials shall water based and be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 40 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-35.
      b. Design Polymerics 3040 with zero VOC’s.
      c. Foster Products Corporation, H. B. Fuller Company; 30-90.
   2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   5. Color: White.

2.04 SEALANTS

A. Joint Sealants:
   1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-76.

b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Marathon Industries, Inc.; 405.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-76.
b. Or equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications and use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.05 FACTORY-APPLIED JACKETS

A. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.06 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. PVC Jacket Color:
a. Heating Hot Water Piping:
1) Heating Hot Water Supply: Dark Red
2) Heating Hot Water Return: Light Red

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.07 REMOVABLE INSULATION JACKETS

A. Manufacturers:
    1. ThermaXX LLC.
    2. INSULTECH.
    3. Firwin.

B. Insulation:
    1. Glass mat, type E needled fiber, 1" at 11.3 LB/CF.
    2. Maximum Use Temperature 400 deg F.

C. Jacket:
    1. Hot Side
        a. PTFE Fiberglass Composite Jacketing, 16.5 oz/sq. yd. minimum
        b. Estimation of Maximum Use Temperature 550 deg F.
    2. Cold Side
        a. PTFE Fiberglass Composite Jacketing, 16.5 oz/sq. yd. minimum
        b. Estimation of Maximum Use Temperature 600 deg F.

D. Thread:
    1. Does not decompose below 800 deg F.
    2. Does not melt.
    3. Diameter: 0.0114
    4. Break Point: 35 Lbs.

E. Construction:
    1. Double sewn lock stitch with a minimum 4 to 6 stitches per inch. Jackets shall be sewn with two (2) parallel rows of stitching. The thread must be able to withstand the skin temperatures without degradation.
    2. Hog rings, staples, and wire are not are not acceptable methods of closure.
    3. No raw cut jacket edges shall be exposed.
    4. Jackets shall be fastened using hook and loop (Velcro) straps and 1” slide buckles.
    5. Provide a permanently attached aluminum or stainless-steel nameplate on each jacket to identify its location, size, and tag number.
    6. Provide a stainless steel or brass grommet at the low point of each jacket, in wet areas for moisture drain (on horizontal jackets as required).
    7. The insulation shall be designed to minimize the convection current in the space between the hot metal surface and the inner layer of insulation. To this end, during jacket fabrication, the layers of insulating mat shall be placed in an overlapping pattern.
    8. All jacket pieces which match mating seams must include an extended 2" flap constructed from the exterior fabric and shall be secured using hook & loop closure (Velcro) parallel to the seam.
    9. Insulation must be sewn as integral part of the jacket to prevent shifting of the insulation.

2.08 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
    1. Products: Subject to compliance with requirements, provide one of the following:
        a. ABI, Ideal Tape Division; 428 AWF ASJ.
        b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
        c. Compac Corporation; 104 and 105.
        d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
    2. Width: 3 inches.
    3. Thickness: 11.5 mils

4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 491 AWF FSK.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   c. Compac Corporation; 110 and 111.
   d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
   b. Compac Corp.; 130.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
   d. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   b. Compac Corp.; 120.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
   d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.09 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch thick, 1/2 inch 3/4 inch wide with closed seal.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, Monel.
1. Manufacturers: Subject to compliance with requirements, provide product by:
   a. C & F Wire.
   b. Childers Products.

c. PABCO Metals Corporation.
d. RPR Products, Inc.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify all inspection and acceptance testing of the piping as required by the specification has been completed and that the piping is ready for installation of insulation.
   2. Verify that surfaces to be insulated are clean and dry.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.
   4. Verify there is adequate clearance to install the pipe insulation in accordance with the operation performance parameters of the specification, such as access to controls, valves and for maintenance and repair.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Insulation shall not be installed until the following have been completed and documentation has been submitted to Contracting Agency for approval and record:
   1. Cleaning and flushing
   2. Pressure testing

B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

H. Keep insulation materials dry during application and finishing.

I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

J. Install insulation with least number of joints practical.

K. Install rigid pre-insulated pipe supports to protect from compression of insulation material due to point loads.

L. Provide aluminum sleeves at all pipe support joints, between hanger support and exterior layer of insulating systems, to protect from compression of insulation material due to point loads.

M. Install insulation on piping accessories requiring future reoccuring access and service with factory fabricated insulation covers that are easily removed and reapplied.

N. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

O. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

P. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1.5 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

Q. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

R. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

S. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

T. Existing pipe insulation damaged or affected by the work of this contract shall be repaired to comply with these specifications except that materials and thicknesses may match existing unless otherwise directed by the Contracting Agency.

U. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations:
1. Terminate insulation with sleeve seal at wall penetration.
2. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations: Install insulation continuously through walls and partitions.

E. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
   6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
   7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
   8. For services not specified to receive a field-applied jacket, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
   9. Label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

B. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

C. Install removable insulation covers at locations indicated. Installation shall conform to the following:
   1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
   2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
   3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
   4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
   5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
   5. On chilled water systems, the butt end of every fourth pipe insulation section, and the ends or raw edges of insulation terminations at equipment connections, fittings and fire stop systems shall be sealed with vapor retarder mastic per NAIMA Guide to Insulation Chilled Water Systems, 2015.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.07 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1.5-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install as follows:
1. With 1-inch overlap at longitudinal seams and end joints; for horizontal applications.
2. Seal with manufacturer's recommended adhesive.
3. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install as follows:
1. With 2-inch overlap at longitudinal seams and end joints.
2. Overlap longitudinal seams arranged to shed water.
3. Seal end joints with weatherproof sealant recommended by insulation manufacturer.
4. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.08 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.09 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range.

3.10 ABOVEGROUND PIPING INSULATION SCHEDULE

A. Heating Hot Water Supply and Return, 200°F and below:
1. NPS 1.25 inch and smaller: Mineral Fiber, pre-formed pipe insulation, 1.5 inches thick.
2. NPS 1.5 inch and larger: Mineral Fiber, pre-formed pipe insulation, 2 inches thick.

B. Condensate Drain Piping:
1. All Pipe Sizes: Flexible elastomeric, 0.5 inch thick.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Concealed: None.

C. Piping, Exposed: PVC, Color-Coded by system, 30 mils thick for all indoor applications.

3.12 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Concealed: None.

C. Piping, Exposed: Aluminum, Stucco Embossed, 0.024 inch thick.

END OF SECTION 23 07 19

This page intentionally left blank

SECTION 23 08 00

COMMISSIONING OF HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.02 SUMMARY

A. General: Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment. Project commissioning and completion of mechanical systems detailed and specified by these Contract Drawings and Specifications shall be provided in accordance with requirements of Washington State Energy Code, to include, but not be limited to, the following:

1. Preliminary Commissioning Report: A preliminary report of commissioning test procedures and results shall be completed and provided to the Owner's Representative. The preliminary commissioning report shall identify:
    a. Deficiencies found during testing required by this section that have not been corrected at the time of report preparation and the anticipated date of correction.
    b. Deferred tests that cannot be performed at the time of report preparation due to climatic conditions.
    c. Climatic conditions required for performance of the deferred tests and the anticipated date of each deferred test.
2. Final Commissioning Report: A complete report of test procedures and results shall be prepared and filed with the Owner's Representative. The final commissioning report shall identify:
    a. Results of all functional performance tests.
    b. Disposition of all deficiencies found during testing, including details of corrective measures used or proposed.
    c. All functional performance test procedures used during the commissioning process including measurable criteria for test acceptance, provided herein for repeatability.

1.03 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.04 INFORMATIONAL SUBMITTALS

A. Certificates of Readiness: Provide.

B. Certificates of Completion of Installation, Prestart, and Startup Activities: Provide.

1.05 ALLOWANCES

A. Labor, Instrumentation, Tools, and Equipment Costs: Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances," Section 01 21 00 "Allowances."

1.06 CONTRACTOR'S RESPONSIBILITIES

A. Commissioning Tests: Perform commissioning tests at the direction of the CxA.

B. Construction Coordination Meetings: Attend construction phase controls coordination meeting.

C. TAB Coordination Meetings: Attend testing, adjusting, and balancing review and coordination meeting.

D. Component Maintenance Orientation and Inspection: Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Commissioning Documentation: Provide information requested by the CxA for final commissioning documentation.

F. Measuring Instruments and Logging Devices: Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.07 CXA'S RESPONSIBILITIES

A. Construction Checklists and Commissioning Process Test Procedures: Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction Contract.

B. Commissioning Testing: Direct commissioning testing.

C. TAB Work: Verify testing, adjusting, and balancing of Work are complete.

D. O&M Manuals: Provide test data, inspection reports, and certificates in Systems Manual.

1.08 COMMISSIONING DOCUMENTATION

A. Commissioning Plan: Provide the following information to the CxA for inclusion in the commissioning plan:
   1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
   2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
   3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
   4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
   5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
   6. Test and inspection reports and certificates.
   7. Corrective action documents.
   8. Verification of testing, adjusting, and balancing reports.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 TESTING PREPARATION

A. Systems Certification: Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Instrumentation and Control Systems Certification: Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest setpoints have been recorded.

C. TAB Procedures and Reports: Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective Work reviewed.

D. Systems Operation: Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspection: Inspect and verify the position of each device and interlock identified on checklists.

F. Smoke Control and Life Safety Systems: Check safety cutouts, alarms, and interlocks with smoke control and life safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.02 TESTING AND BALANCING VERIFICATION

A. Documents: Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notification: Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

C. Additional TAB Support: Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
   1. The CxA will notify Testing and Balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
   2. The Testing and Balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
   3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
   4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.03 GENERAL TESTING REQUIREMENTS

A. Additional Commissioning Support: Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC&R Testing: Shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Testing Requirements: Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. Testing Plans, Procedures, and Checklists: The CxA, along with the HVAC&R Contractor, Testing and Balancing Contractor, and HVAC&R Instrumentation and Control Contractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Testing Conditions: Tests will be performed using design conditions whenever possible.

F. Simulated Conditions: Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. Setpoints: The CxA may direct that setpoints be altered when simulating conditions is not practical.

H. Testing Deficiencies: The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering setpoints are not practical.

I. Seasonal Testing: If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner’s Representative. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.04 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in HVAC boiler sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.

B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 23 09 00 “Instrumentation and Control for HVAC” and Section 23 09 93 “Sequence and Operations for HVAC Controls.” Assist the CxA with preparation of testing plans.

C. Cleaning, Flushing, and Hydrostatic Testing Plan: Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
   1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
   2. Description of equipment for flushing operations.
   3. Minimum flushing water velocity.
   4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of heat pump and solar systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

E. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

F. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

G. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION 23 08 00

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.02 RELATED REQUIREMENTS

A. Section 23 00 00 "General Mechanical Requirements"

B. Section 23 05 19 "Meters and Gauges for HVAC Piping" for measuring equipment that relates to this section.

C. Section 23 05 49 "Variable Frequency Drives. "

1.03 DEFINITIONS

A. DDC:
Direct digital control.

B. I/O:
Input/output.

C. BACnet, and Tridium:
Control network technology platforms for designing and implementing interoperable control devices and networks.

D. MS/TP:
Master slave/token passing.

E. PC:
Personal computer.

F. PID:
Proportional plus integral plus derivative.

G. RTD:
Resistance temperature detector.

1.04 WORK BY OTHERS

A. General:
Mechanical Contractor installs control valves, taps, and dampers furnished by BAS manufacturer.

B. Electrical Contractor Provides:
1. Power: 120 V power to BAS and/or temperature control panels as shown on Electrical Plans.
2. Wiring: Wiring of power feeds through disconnect starters to electrical motor.
3. Stop/Start Switches: Wiring of remote stop/start switches and manual or automatic motor speed control devices not furnished by BAS manufacturer.
4. Sub-Metering: Wiring of electrical sub-metering devices furnished by BAS manufacturer as shown on Electrical Plans.

1.05 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:
1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within 6 seconds.

5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within 5 seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as 5 seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
    a. Water Temperature: Plus or minus 1 degrees F.
    b. Water Flow: Plus or minus 5 percent of full scale.
    c. Water Pressure: Plus or minus 2 percent of full scale.
    d. Space Temperature: Plus or minus 1 degrees F.
    e. Ducted Air Temperature: Plus or minus 1 degrees F.
    f. Outside Air Temperature: Plus or minus 2 degrees F.
    g. Dew Point Temperature: Plus or minus 3 degrees F.
    h. Temperature Differential: Plus or minus 0.25 degrees F.
    i. Relative Humidity: Plus or minus 5 percent.
    j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
    k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
    l. Airflow (Terminal): Plus or minus 10 percent of full scale.
    m. Air Pressure (Space): Plus or minus 0.01-inch w.g.
    n. Air Pressure (Ducts): Plus or minus 0.1-inch w.g.
    o. Carbon Monoxide: Plus or minus 5 percent of reading.
    p. Carbon Dioxide: Plus or minus 50 ppm.
    q. Electrical: Plus or minus 5 percent of reading.

1.06 SEQUENCE OF OPERATION

A. General:
See Drawings for control sequences.

1.07 ACTION SUBMITTALS

A. Product Data:
Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
    1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
    2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
    3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings:
Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
    1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
    2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
    3. Wiring Diagrams: Power, signal, and control wiring.
    4. Details of control panel faces, including controls, instruments, and labeling.
    5. Written description of sequence of operation.
    6. Schedule of dampers including size, leakage, and flow characteristics.
    7. Schedule of valves including flow characteristics.

8. DDC System Hardware:
   a. Wiring diagrams for control units with termination numbers.
   b. Schematic diagrams and floor plans for field sensors and control hardware.
   c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
9. Controlled Systems:
   a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
   b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
   c. Written description of sequence of operation including schematic diagram.
   d. Points list.

C. Samples for Initial Selection:
For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.

D. Samples for Verification:
For each color required, of each type of thermostat or sensor cover.

1.08 INFORMATIONAL SUBMITTALS

A. Data Communications Protocol Certificates:
Certify that each proposed DDC system component complies with ASHRAE 135.

B. Qualification Data:
For Installer and manufacturer.

C. Software Upgrade Kit:
For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

D. Field quality control test reports.
Provide.

1.09 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:
For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 “Operation and Maintenance Data,” include the following:
1. Maintenance instructions and lists of spare parts for each type of control device and compressed air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of setpoints.

B. Software and Firmware Operational Documentation:
Include the following:
1. Software operating and upgrade manuals.
2. Program Software Backup: On compact disc or electronically, complete with data files.
3. Device address list.
4. Printout of software application.
5. Software license required by and installed for DDC workstations and control systems.

1.10 QUALITY ASSURANCE

A. Installer Qualifications:
Automatic control system manufacturer’s authorized representative who is trained and approved for installation of system components required for this Project.

B. Electrical Components, Devices, and Accessories:
Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with ASHRAE 135 for DDC system components.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components:
Where control devices specified in this section are indicated to be factory-mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software:
Update to latest version of software at Project completion.

1.12 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Section 28 16 00 “Intrusion Detection” to achieve compatibility with equipment that interfaces with that system and with building master clock.

C. Coordinate equipment with Section 28 13 00 “Access Control” to achieve compatibility with equipment that interfaces with that system.

D. Coordinate equipment with Section 26 09 43.13 “Addressable-Fixture Lighting Controls” and Section 26 09 43.23 “Relay-Based Lighting Controls” to achieve compatibility with equipment that interfaces with that system.

E. Coordinate equipment with Section 28 46 11 “Digital, Addressable Fire-Alarm System” and Section 28 31 12 “Zoned (DC Loop) Fire-Alarm System” to achieve compatibility with equipment that interfaces with that system.

F. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

G. Coordinate equipment with Section 26 09 13 “Electrical Power Monitoring and Control” to achieve compatibility of communication interfaces.

H. Coordinate equipment with Section 26 24 16 “Panelboards” to achieve compatibility with starter coils and annunciation devices.

I. Coordinate size and location of concrete bases. Cast anchor bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03 30 00 “Cast-in-Place Concrete.”

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. BAS Software Manufacturers:
System software graphics and programming shall be as manufactured by:
1. Alerton BACnet or Tridium Niagara (provided by ATS Automation)
2. Johnson Controls BACnet or Tridium Niagara
3. Siemens BACnet or Tridium Niagara (provided by local Siemens factory office)
4. Distech BACnet or Tridium Niagara (provided by Long Building Controls)
5. Honeywell BACnet or Tridium Niagara

B. BAS Hardware Manufacturers:
System components, except where specified otherwise, shall be as manufactured by:
1. Alerton BACnet (provided by ATS Automation)
2. Johnson Controls BACnet
3. Siemens BACnet (provided by local Siemens factory office)
4. Distech BACnet (provided by Long Building Controls
5. Honeywell BACnet or LonTalk (provided by Sound Energy Systems)

C. System Requirements:
System components shall be, to greatest extent possible, manufactured by a single manufacturer. Local branch (or company) engineers and technicians shall directly supervise installation and point-to-point checkout of installing subcontractor. This local branch (or company) shall maintain a service organization that stocks, and has direct factory access to, manufacturer's standard parts and shall be capable of system inspection, troubleshooting, maintenance, and service.

2.02 SYSTEM DESCRIPTION

A. General:
1. Distributed Logic BAS: Provide complete with software and hardware functions. This system shall control mechanical equipment including unitary equipment such as VAV boxes, heat pumps, fan coils, AC units, and air handlers as detailed in this Specification.
2. BAS: Provide a fully distributed processing, online, real-time, direct digital control building controls subsystem as an integral part of BAS, in compliance with applicable codes and as reviewed by authorities having jurisdiction at Project site. Communication between nodes shall be digital only.
3. Auto Communications: Network shall support internet access via Owner's internet provider for e-mailed alarm access.
4. Remote Access Software: Provide remote access software. Workstation shall function as a host to remote users via internet connectivity through an Owner-provided network and secured through the Owner's firewall. VPN access shall be required and provided by the Owner.
5. Open Architecture at field controller levels: Network shall utilize an open architecture capable of one or more of following:
    a. Connectivity via BACnet as per ANSI/ASHRAE Standard 135.
6. Additional Requirements: BAS shall interact with equipment such as heat pumps, Lighting control or local controllers that are provided by other trades. BAS Contractor shall provide equipment and connections to integrate these devices.

B. BAS Software BACnet or Tridium Niagara 4.0
Operator's workstation software shall be Microsoft Windows, most current version supported by BAS manufacturer. Software shall include password protection, alarming, logging of historical data, graphics including animation, suite of field engineering tools including graphical programming, and applications.
1. Building Controllers: Include complete energy management software, including scheduling building control strategies and logging routines. Energy management software and firmware shall be resident in field hardware and shall not be dependent on operator's terminal. Operator's terminal software shall be used for access to field-based energy management function only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, run-time accumulation, equipment alarm reporting, and override timers for after-hours usage.
2. Central Plant and Air Handler Controller:
    a. Expandable application controller shall be capable of providing custom control strategies to meet the sequence of operation. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site though simple download are not acceptable. Changing global strategies using firmware changes is also unacceptable. Program execution of controller shall be a minimum of once per second.
    b. Controller shall have adequate data storage to ensure high performance and data reliability. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative). Battery shall be a field-replaceable (non-rechargeable) lithium type. Unused battery life shall be 10 years.
    c. The on-board, battery-backed real-time clock must support schedule operations and trend logs.

d. Controller shall include both onboard 10Base-T/100Base-TX Ethernet BACnet communication over UTP and shall include BACnet IP communication. In addition, controller shall include BACnet point-to-point (PTP) connection port.
e. The base unit of the controller shall host up to eight expansion modules with various I/O combinations. These inputs and outputs shall include universal 12-bit inputs, binary triac outputs, and 8-bit switch-selectable analog outputs (0–10V or 0–20mA). Inputs shall support 3K and 10K thermistors, 0–5VDC, 0–10VDC, 4–20mA, dry contacts, and pulse inputs directly.
f. All outputs must have onboard hand-off-auto (HOA) switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position.
g. The position of each and every HOA switch shall be available system wide as a BACnet object.

3. Application Controllers: Provide for every terminal unit (HP), air handler, central plant equipment, and other programmable controlled equipment. Application controllers shall be mounted next to controlled equipment and communicate with building controller via LAN.

2.03 NETWORK

A. First Tier Communications:
First tier network shall provide communications between operator workstations and first tier network controllers. It shall be based on PC industry standard Ethernet TC/IP and shall use BACnet or Tridium Niagara as first tier network communication protocol. First tier network shall operate at a minimum communication speed of 10 Base-T or 100 Base-TX, with full peer-to-peer network communication. Workstation and network controller LAN cards shall be standard “off-the-shelf” products available through normal PC vendor channels.

B. First Tier Network:
First tier network shall be provided on its own dedicated cable as a private network, unless otherwise noted on Drawings, Specifications, or by prior review. BAS network shall support both copper and optical fiber communication media to comply with applicable codes, ordinances, and regulations and authorities having jurisdiction. It shall be color coded and labeled with BAS manufacturer’s name.

C. Interconnecting Devices:
Provide gateways, routers, repeaters, transceivers, hubs, and other devices to interconnect operator workstations and network controllers. Equipment shall comply with IEEE 802.3 or Ethernet Version 2 (V2.0) specifications.

D. Telephone Lines:
Owner shall provide private and public telephone lines, ISDN lines, and Internet Service Provider connections for Contractor to complete BAS work as specified, at Owner’s cost. Contractor shall identify specific BAS requirements in a Shop Drawing submittal.

E. IT Interface Equipment:
Provide IT interfacing equipment and coordinate on configuration and interfacing arrangements with Data Cabling System Contractor.

F. Second Tier Networks:
Second tier networks shall provide either peer-to-peer, master-slave, or supervised token passing communications, and shall operate at a minimum communication speed of 9.6 to 76.8 Kbps. Application-specific controllers shall reside on second tier. Communication protocol can be BACnet or LonTalk.

G. Third Party Interface:
1. BAS Contractor:
a. Shall integrate real-time data from building systems and databases originating from others.
b. Shall not be responsible for execution of scheduling of Work of other trades.

2. Contractors Supplying other Associated Systems and Equipment: Contractors shall provide hardware and software and cooperate fully with BAS Contractor at their cost to ensure complete data integration.
3. BAS: BAS hardware equipment and software shall allow data communications between BAS building systems supplied by others, utilizing standard protocols of LonWorks, BACnet, and/or Modbus. See sequence of operation for details.
4. Integration: Third-party interfaces shall extend to operator's workstation software, which shall support user interaction with all control system components. Methods of integration shall include industry standard protocols such as BACnet, LonMark/LonTalk, OLE for Process Control (OPC), Modbus, or integrator interfaces between cooperating manufacturer's systems.

2.04 WEB INTERFACE

A. BAS Supplier:
BAS supplier shall provide graphical interface that allows users to access real-time BAS data, configure data, archive data, monitor, command, commission, edit, and perform system diagnostics via Internet or Intranet from devices with Web browser software as a part of standard installation. Interface shall use HTML-based ASP pages or Hypertext Transfer Protocol (HTTP), Internet Protocol (IP), Simple Network Time Protocol (SNTP), Simple Mail Transfer Protocol (SMTP), Simple Network Management Protocol (SNMP), and Extensible Markup Language (XML) to send and receive data from DDC system to a Web browser. Web software shall be included that allows unlimited simultaneous users to access DDC system, with ability to expand system to accommodate an unlimited number of users. Web browser shall tie into network via Owner-supplied Ethernet network connection. BAS supplier shall not utilize Owner's existing server as a platform for Web- based interface.

B. Browser:
Browser shall be standard version of Microsoft IE latest release, Google Chrome, or Mozilla Firefox latest release. No special vendor- supplied software shall be needed on computers running browser. BAS data shall be accessed from standard Web browser devices (desktop or laptop computer) connected to network, including remote users connected by an Internet Service Provider. Displays shall be viewable and Web server shall directly access real-time data from BAS network. Data shall be displayed in real time and update automatically without user interaction. User shall be able to change data on displays if logged in with user name and password.

2.05 BUILDING CONTROLLER

A. General:
Building controller shall be capable of providing building-wide network control strategies for system based on information from a system object regardless of whether object is directly monitored by controller or by another controller. Program that implements these strategies shall be completely flexible and user definable. Systems utilizing factory pre-programmed strategies that cannot be modified by field personnel on site or downloaded via remote communications are not acceptable. Changing Building Controller strategies via firmware changes is also unacceptable.

B. Programming:
Programming shall be object-oriented using control function blocks, supporting DDC functions, with analog and binary values to accomplish sequences. Flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be resident on workstation. Contractor shall provide programming tools for controllers.

C. Graphical View:
Provide means to graphically view inputs and outputs to each program block in real time as program is executing. This function shall be performed via operator's workstation or field computer.

D. Real Time:
Building controller shall provide battery backup real-time (hardware) clock functions.

E. Memory:
Controller shall have memory needed to ensure high performance and data reliability. Battery shall retain static RAM memory for a minimum of 1.5 years, cumulative. Battery backup shall provide real time clock functions for a minimum of 72 hours.

F. Control Functions:
Global control algorithms and automated control functions shall execute via a 64-bit processor.

G. Battery:
Controller installation shall include memory-free gel-cell battery providing ongoing power conditioning and noise filtering for operation data integrity. It shall provide a minimum of five minutes of powerless operation.

H. Schedules:
Each building controller shall support schedule and calendar objects for number of zones of control connected to building controller.

I. Logging Capabilities:
1. Trend Logs: Each building controller shall log points (real or calculated) located in building controller. Objects in system (real or calculated) shall be logged. Sample time interval shall be adjustable at operator's workstation.
2. Points: Points, physical or calculated, may be designated for trending. Trending may be triggered on a defined time interval, upon a change in value, or when a value exceeds a range.
3. Remote Locations: Logs shall be viewed either on site or off site via remote communication.
4. Building Controller: Controller shall periodically upload trended data to networked operator's workstation for long-term archiving if desired.
5. Archived Data: Data stored in database format shall be available for use in third-party spreadsheet or database programs.

J. Alarm Generation:
1. Alarms:
   a. Alarms shall be generated within system for object change of value or state, either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
   b. Each alarm shall be distributed via text, phone, or e-mail as noted above.
2. Alarm Log: Provide for alarm viewing. Log shall be viewed on site at operator's terminal or off-site via remote communications.
3. Alarm Messages: In addition to point's descriptor and time and date, user shall be able to print, display, or store a minimum 65-character alarm message to more fully describe alarm condition or direct operator response. Each standalone building controller shall be capable of storing a library of alarm messages sufficient for number of alarm points in building controller. Each message may be assignable to number of points in panel.

2.06 CENTRAL PLANT AND AIR HANDLER APPLICATION CONTROLLERS

A. General:
Provide one controller for each air handler and for central plant control that covers objects listed in object list. Controllers shall include input, output, and self-contained logic program needed for complete control of units. Controllers shall be fully programmable. Programming tool shall be resident on operator workstation.

B. Application Controllers:
Application controllers shall include analog and binary inputs with 10-bit resolution that accepts 3K or 10K thermistors, 1,000 Ohm RTD temperature elements, NI, SI, PT, 0 to 10 VDC, 0 to 5 VDC, 4 to 20 mA, and dry contact signals. Controller shall include binary and analog outputs on board. Analog outputs shall be either 0 to 10 VDC or 0 to 20 mA. Software shall include scaling features for analog outputs. Include 24 VDC voltage supply for use as power supply to external sensors.

C. Programming Sequences:
Program sequences shall be stored on board application controller in flash RAM. No batteries shall be needed to retain logic program during normal operations. Programming of application controller shall be completely modifiable in field over provided LANs or remotely via modem interface. Application controller shall be programmed using programming tools as described in operator's terminal section.

D. Base Unit:
Base unit of controller shall host expansion modules with various I/O combinations. These inputs and outputs shall include several combinations of binary inputs and outputs and analog inputs and outputs. Inputs shall support thermistors, dry contacts, or pulse inputs directly.

E. Time Clock:
Each controller shall support its own real-time operating system. Provide a time clock with battery backup to allow standalone operation and ensure protection during power outages. Clock operation shall be overridden by Universal Network controller time clock to ensure network continuity.

F. Storage:
Databases and programs shall be stored in non-volatile flash RAM or a minimum of 100-hour battery backup shall be provided. Upon transfer from normal to emergency power and back to normal power, DDC controlled setpoints, proportional bands, control algorithms, and other programmable parameters shall be maintained such that a normal power failure does not necessitate reprogramming or rebooting of controller and control functions shall proceed as if no interruption of normal power occurred. Programs shall be field-customized to meet user's exact control strategy requirements.

G. Certifications:
Controller shall be listed for UL 916

H. Manual Overrides:
1. Manual Override Switches: Provide for binary outputs. Switches shall be mounted within system controller key accessed enclosure or adjacent local control panel.
2. Switches for Analog Outputs: Switches shall be rotary gradual position, providing full analog signal range of associated analog output, and shall be operable whether panel processor is operational or not.

2.07 TERMINAL UNIT APPLICATION CONTROLLERS (HEAT PUMPS, FAN COILS)

A. General:
Provide one unitary controller for each piece of unitary mechanical equipment that covers objects listed in object list for unit. Controllers shall interface to building controller via LAN. Controllers shall include input, output, and self-contained logic program as needed for complete control of unit. Each unitary controller shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in network. Each unitary controller shall be a microprocessor based, multi-tasking, real-time digital control processor.

B. Unitary Controllers:
Unitary controllers shall include analog and binary inputs that accept 3K or 10K thermistors, 1,000 Ohm RTD temperature elements NI, SI, or PT, 0 to 10 VDC, 0 to 5 VDC, 4 to 20 mA, and dry contact signals. Controller shall include binary and analog outputs onboard as needed. Analog outputs shall be either 0 to 10 VDC or 0 to 20 mA. Software shall include scaling features for analog outputs. Provide 24 VDC voltage supply for use as power supply to external sensors.

C. Storage:
Program sequences shall be stored on board controller in flash RAM. No batteries shall be needed to retain logic program.

D. Power Fail Protection:
System setpoints, proportional bands, control algorithms, and other programmable parameters

shall be stored such that a power failure does not necessitate reprogramming controller. Programming of application controller shall be completely modifiable in field over provided LANs or remotely via modem interface. Unitary controllers shall directly support temporary use of a portable service terminal that can be connected via zone temperature sensor or directly at controller. Vendor-specific programming tools shall be provided as part of system (other than a standard laptop).

E. Certifications:
UL 916,

2.08 WORKSTATION OPERATOR INTERFACE

A. General:
General structure of workstation interaction shall be a standard client/server relationship. Server shall be used to archive data and store system database. Clients shall access server for archived data. Each client shall include flexibility to access graphics from server or local drive. Provide software licenses for server and each client.

B. Displays:
1. Operator's Workstation (OWS): Displays data associated with projects as called out on Drawings and/or object type list supplied. Graphic files shall be created using depictions of system installation, AutoCAD or Visio drawing files of field installation drawings, and wiring diagrams from as-built drawings. OWS shall display data using 3-dimensional graphic representations of mechanical equipment. System shall be capable of displaying graphic file, text, and dynamic object data together on each display and shall include animation. Information shall be labeled with descriptors and shall be shown with engineering units. Information on display shall be dynamically updated without action by user. Workstation shall allow user to change field resident EMCS function associated with Project, such as setpoints, weekly schedules, and exception schedules, regardless of whether a particular screen shows text or a complete graphic display. This shall be done without reference to object addresses or other numeric/mnemonic indicators.
2. Programming: Displays and programming shall be generated and customized by local BAS supplier and installer. BAS graphics programmer shall meet with Owner and consultants prior to creating graphical displays, to discuss graphical format, point naming conventions, what information is to be displayed, customizing screens to comply with Owner needs, and how graphic screens shall appear. Systems requiring factory programming for graphics or DDC logic are specifically prohibited.
3. BAS Operator Interface: Interface shall be user friendly, readily understood, and shall make maximum use of colors, graphics, icons, embedded images, animation, text-based information, and data visualization techniques to enhance and simplify use and understanding of BAS by authorized users at OWS.
4. Passwords: User access to BAS shall be protected by a flexible and Owner- redefinable software-based password access protection. Password protection shall be multi-level and partitionable to accommodate varied access requirements of different user groups. Provide means to define unique access privileges for each individual authorized user. Provide means to manage online password access control under control of a master password.
5. Supported Functions: Operator interface shall incorporate comprehensive support for functions including, but not necessarily limited to, following:
    a. User access for selective information retrieval and control command execution.
    b. Monitoring and reporting.
    c. Alarm and non-normal condition annunciation.
    d. Selective operator override and other control actions.
    e. Information archiving, manipulation, formatting, display, and reporting.
    f. BAS internal performance supervision and diagnostics.
    g. Online access to user help menus.
    h. Online access to current BAS as-built records and documentation.

i. Means for controlled reprogramming, reconfiguration of BAS operation, and for manipulation of BAS database information in compliance with prevailing codes, approvals, and regulations for individual BAS applications.
j. Provide BAS reports and displays making maximized use of simple English language descriptions and readily understood acronyms and abbreviations to assist user understanding and interpretation. Text naming conventions shall be consistent in their use and application throughout BAS.
k. PC-based configurations shall operate on Microsoft Windows 7 or most current version supported by BAS manufacturer.

6. Alarms:
   a. Designated OWS shall annunciate alarms generated by BAS. Alarm management portion of OWS software shall, at minimum, provide following functions:
      1) Log date and time of alarm occurrence.
      2) Generate a “pop-up” window with audible alarm, informing a user that an alarm has been received.
      3) Allow a user with appropriate security level to acknowledge or disable an alarm.
      4) Provide an audit trail on hard drive for alarms by recording user acknowledgement, deletion, or disabling of alarm. Audit trail shall include name of user, alarm, action taken on alarm, and time/date stamp.
   b. BAS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions.
   c. BAS shall annunciate application alarms.
7. Reports:
   a. Reports shall be generated and directed to one or more of following: OWS display, printer, or archive at user’s option. As a minimum, system shall provide following reports:
      1) Points in BAS.
      2) Points in each BAS application.
      3) Points in a user-defined group of points.
      4) Points currently in alarm.
      5) Points locked out in a BAS application.
      6) BAS schedules.
      7) User defined and adjustable variables, schedules, and interlocks.
8. Dynamic Color Graphics:
   a. An unlimited number of graphic displays shall be able to be generated and executed.
   b. Graphic displays shall be able to display and provide animation based on real-time BAS data that is acquired, derived, or entered.
   c. User shall be able to change values (setpoints) and states in system-controlled equipment.
   d. Provide a graphic editing tool that allows for creation and editing of graphic files.
   e. BAS system shall be provided with a complete user expandable symbol library containing basic symbols used to represent components of this BAS system.
9. Schedules:
   a. Provide a spreadsheet style schedule input form for automatic BAS time-of-day scheduling and override scheduling of BAS operations. At a minimum, following spreadsheet types shall be accommodated:
      1) Weekly schedules.
      2) Temporary override schedules.
      3) Special “Only Active if Today is a Holiday” schedules.
   b. Schedules shall be provided for each system or sub-system in BAS. Each schedule shall include commandable points residing within system. Each point may have a unique schedule of operation relative to system schedule, allowing for sequential starting and control of equipment within system. Scheduling and rescheduling of points shall be accomplished easily via system schedule spreadsheets.

c. Monthly calendars for a 12-month period that allow for simplified scheduling of holidays and special days in advance shall be provided. Holidays and special days shall be user selected with pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on weekly schedules.

10. Internet/Intranet Browser:
    a. Multi-user color graphics, textual interface, and server shall be provided that allows customers to access their BAS data via Internet and Intranet. This interface shall use HTML-based pages to send and receive data from a BAS to a Web browser:
    b. Browser shall:
        1) Automatically reflect changes made to BAS without additional programming.
        2) When provided behind a corporate firewall, work in conjunction with other security measures that have been implemented.
        3) Allow user to navigate and command BAS using same format as OWS.
        4) Be an industry standard browser.
        5) Provide user password access control.
        6) Provide means by which user can create, edit, and view groups of BAS data points.
        7) Provide navigation tools for moving between views. In addition, it shall provide tools for gaining access to help and for logging out of system.
11. Remote Alarm Notification:
    a. Provide a flexible alarm notification for communicating critical conditions of BAS to a minimum of 300 different devices and destinations.
    b. Building operators shall be able to monitor and respond to critical BAS conditions via workstation, a separate personal computer (PC) on a connected internet protocol (IP) network, phone, or other mobile, electronic devices.
    c. Provide software program to facilitate productivity of Owner's maintenance staff by helping Owner filter alarms that need to be sent, define alarm actions to be performed, and configure communication details for selected notification options.
    d. Schedules shall allow Owner to send alarm messages only if a particular user is available according to a defined schedule. Schedule set-up shall allow alarm notification for groups or individuals.
    e. Provide following notification options:
        1) Pager Option: Sends messages to pagers using Tele Alphanumeric Protocol (TAP) and to Simple Message System (SMS) pagers using Universal Network System for Mobile Communications (GSM). BAS supplier shall be responsible for providing a modem for connection to paging service.
        2) Email Option: Sends e-mail messages to one or several e-mail recipients.
        3) Texting: Sends a message using Owner's phone provider's system for texting.
        4) Sound/Text-to-Speech Option: Plays a prerecorded sound file or a speech converted from a text file on a local computer or remotely over network.
        5) Phone Callout Option: Calls a defined phone number and either plays a prerecorded sound file or a defined text file that is automatically converted to speech.

C. Password Protection:
Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator's assigned functions when user is logged on. This includes displays as outlined above.

D. Operator Activity Log:
1. General: System shall include an activity log that tracks operator changes and activities. Activity log shall track what is changed in system, who performed this change, date and time of system activity, and value of change before and after operator activity. Operator shall be able to display activities and sort changes by user and by operation.

2. Data Management: Log shall be gathered and archived to hard drive on operator workstation as needed. Operator shall be able to export data for display and sorting in a spreadsheet.
3. Displayed Data: Any displayed data that is changeable by operator shall be selected and operator activity log shall then be selectable on screen. Selection of operator activity log using this method shall show operator changes of just that displayed data.

E. Trend Log:
1. General: System server shall periodically gather historically recorded data stored in building controllers and field controllers and archive information gathered. Archived files shall be appended with new sample data, allowing samples to be accumulated. Systems that write over archived data shall not be allowed, unless limited file size is specified. Samples shall be viewed at operator's workstation. Operator shall be able to scroll through trended data. Trend log information shall be displayed in standard engineering units.
2. Graphs: Software shall be capable of graphing trend logged object data and creating two-axis (x and y) graphs that display up to 10 object types at same time in different colors. Graphs shall show object values relative to time.
3. Setup: Operator shall be able to change trend log setup information. This includes information to be logged as well as interval at which it is to be logged. Input, output, and value object types in system shall be logged. Operations shall be password protected. Setup and viewing shall be accessed directly from graphics on which object is displayed.
4. Trend Scheduler: System shall include a trend scheduler for setup of logs. Scheduler shall walk user through steps. Scheduler shall have its own pull down selection for startup, or shall be started by clicking on value displayed on graphic, and then selecting trend logs from displayed menu.

F. Energy Log:
1. General: System server shall be capable of periodically gathering energy log data stored in field equipment and archiving information. Archive files shall be appended with new data, allowing data to be accumulated. Systems that write over archived data shall not be allowed unless limited file size is specified. Display energy log information in standard engineering units.
2. Data: All data shall be stored in database file format for direct use by third-party programs. Operation system shall stay completely online during graphing operations.
3. Setup: Operator shall be able to change energy log setup information as well. This includes meters to be logged, meter pulse value, and type of energy units to be logged. Meters monitored by system shall be logged. System shall support using flow and temperature sensors for Btu monitoring.
4. Display: System shall display archived data in tabular format form for both consumption and peak values. Data shall be shown in hourly, daily, weekly, monthly, and yearly formats. In each format, user shall be able to select a specific period of data to view.

G. Configuration/Setup:
Provide means for operator to display and change system configuration. This shall include, but not be limited to, system time, day of week, date of daylight savings set forward/set back, printer termination, port addresses, and modem port and speed. Items shall be monitored using understandable terminology with simple mouse/cursor key movements.

H. Field Engineering Tools:
Operator's workstation software shall include field engineering tools for programming controllers supplied.
1. Zoom: Provide zoom in and zoom out capabilities.
2. Real-Time Operation: Programming tools shall include a real-time operation mode.
3. Applications: Field engineering tools shall include a database manager of applications that includes logic files for controllers and associated graphics. Operator shall be able to select unit type, input/output configuration, and other items that define unit to be controlled. Supply applications as part of workstation software.

I. Software:
At conclusion of project, Contractor shall leave with Owner an electronic media copy that includes complete software operation system and project graphics, setpoints, and system parameters. This backup shall allow Owner to completely restore system in case of a computer malfunction.

2.09 WORKSTATION HARDWARE REQUIREMENTS

A. General:
Provide hardware and operating system software, drivers, and miscellaneous components to following minimum configuration:
1. Minimum Requirement: Intel Core i7 Processor, or faster.
2. Input Devices: USB optical mouse, keyboard.
3. Monitor: 24.00-inch flat screen monitor.
4. RAM: 16 GB RAM.
5. Hard Disk: 1 TB
6. Graphics: High-performance graphics adapter.
7. Network Card: Ethernet 10/100 network interface card, wireless Ethernet card.
8. Software: Microsoft Windows, most current version supported by BAS manufacturer.
9. USB Ports: Six.

2.10 PORTABLE LAPTOP HARDWARE REQUIREMENTS

A. General:
Provide hardware, operating system software, BAS software, drivers, and miscellaneous components to meet following minimum configuration.
1. Minimum Requirement: Intel I7, or equivalent.
2. Screen: 15.00 inch.
3. RAM: 16 GB RAM minimum.
4. Hard Disk: 1 TB.
5. Network Card: Wireless Ethernet 10/100 network interface card.
6. Software: Microsoft Windows or most current compatible version.
7. USB Ports: Two.

2.11 FIELD DEVICES

A. Temperature Sensors:
1. General:
   a. Room temperature sensors shall be provided where indicated on Drawings. Temperature sensors shall be solid-state electronic, factory calibrated. Sensor accuracy shall be 0.36 degrees F over range of 40 to 100 degrees F. Mount centerline of sensor 48.00 inches above finished floor unless otherwise indicated on Architectural room elevations.
   b. Duct sensors shall be rigid or flexible probe. Sensors in mixed air stream shall be averaging type with sensor element length for complete duct coverage (provide at least 1.00 feet of element length per 2.00 square feet of duct cross sectional area) arranged to cover entire duct area evenly. Sensor accuracy shall be 0.5 degrees F over range of 40 to 180 degrees F.
   c. Control Contractor shall provide immersion sensors to Mechanical Contractor. Mechanical Contractor shall provide immersion sensors in wells filled with thermal compound before installation of immersion sensors. Sensor accuracy shall be 0.5 degrees F over range of 40 to 200 degrees F.
   d. Outside air sensors shall be provided away from exhaust or relief vents, not in an outside air intake and in location that is in shade most of day. Provide outside air temperature sensors with watertight inlet fitting and sunlight shield. Sensor accuracy shall be 0.5 degrees F over range of minus 40 to 120 degrees F.
2. Intelligent Room Sensor with LCD Readout:
   a. Sensor shall contain a backlit LCD digital display and user function keys along with temperature sensor. Controller shall function as room control unit, shall allow

occupant to raise and lower setpoint, and activate terminal unit for override use – all within limits as programmed by building operator. Sensor shall also allow service technician access to hidden functions as described in Sequence of Operation.

b. Sensor shall display room temperature. Unit shall be programmable. Unit shall have capability to show temperatures in Fahrenheit or Centigrade.
c. Override time shall be set and viewed. Override time countdown shall be automatic, but shall be reset to zero from sensor by occupant.
d. Allow fan speed selection based upon fan operation allowed by controller.
e. See Sequence of Operation for specific operation of LCD displays and function keys in field service mode and in normal occupant mode.
f. Field service mode shall be customizable to fit different applications.

3. Wall Sensor with Adjustable Setpoint: Standard wall sensor shall use solid-state sensor identical to intelligent room sensor and shall be packaged in aesthetically pleasing enclosure. Sensor shall provide override function, warmer/cooler lever for setpoint adjustment, and port for plug-in of laptop or field service tool for field adjustments. Override time shall be stored and be adjustable on a zone-by-zone basis. Adjustment range for warmer/cooler lever shall also be stored in non-volatile RAM on controller. Programmable variables shall be available to field service tool or laptop through wall sensor port (RJ-11 jack).
4. Wall Sensor with Nonadjustable Setpoint: Room sensors shall be architecturally pleasing with blank cover, sense temperature, and allow tenant to override system. Setpoints shall be adjustable from operator workstation, laptop, or field service tool.
5. Guards: Heavy-duty plastic coated metal type with secure backing plate, removable with a Phillips screwdriver. Provide protective metal guards on room sensors located in public lobbies, corridors, or where sensors are subject to damage.
6. Freeze Thermostat: Electric low temperature switch with manual reset, adjustable setpoint 15 to 55 degrees F, and sensing element. A 20.00-foot-long non-averaging sensing element shall activate switch whenever 1.00-foot section or more of section senses a temperature as low as thermostat setpoint. Provide two contacts, one for fan shutdown and one for control system alarm.

B. Humidity Sensors:
1. General: Relative humidity (RH) sensors shall use bulk polymer or thin film capacitive type non-saturating sensing elements capable of withstanding a saturated condition without permanently affecting calibration or sustaining damage. Sensors shall include removable protective membrane filters. Sensors shall have an accuracy of plus or minus 2 percent of full scale with a temperature dependence of less than plus or minus 2 percent from 20 to 100 degrees F. A transmitter located at sensor shall be provided to convert sensor output to a linear 4 to 20 mA DC output corresponding to humidity span. Transmitter shall include non-interacting zero and span adjustments. Sensor and transmitter shall be wall mount or duct mount type as indicated on Contract Drawings. Where required for exterior installation, sensors shall be capable of surviving below freezing temperatures and direct contact with salt laden air without affecting sensor calibration.
2. Humidistat (Duct Mounted): Humidistat shall consist of a polymer sensor to provide accurate sensing with increased resistance to chemical corrosion. Contact shall open when setpoint is reached and shall not close until humidity in duct falls 5 percent below setpoint. Relay contact shall be rated 4 amps at 24 VAC.
3. Space Humidistat: Humidistat shall have positive ON-OFF settings to allow manual operation of controlled equipment. Device shall have an impact-resistant, molded plastic cover and shall be capable of being mounted on wall. Full enclosed SPDT; snap acting switch shall be rated for 2 amps at 24 VDC. Sensing element shall consist of a thin, moisture-sensitive nylon ribbon that provides operation even when ambient temperature conditions change.

C. Electric Damper Actuators:
1. General: Damper actuators shall be Brushless DC Motor Technology with stall protection, bi-directional, fail-safe spring return. Provide spring return actuators where damper is in

direct contact with outside air and where applicable for spring return. Damper actuators shall have metal housing, manual override (on actuators except VAV boxes, heat pumps, with independently adjustable dual auxiliary switch.

2. Electric Control Actuation: Direct coupled actuators shall be utilized for electric control actuation. Siemens, Johnson Controls, Invensys, or Belimo.
3. Assembly: Actuator assembly shall include hardware for mounting and connection to a standard 0.50-inch-diameter shaft or damper blade. Actuators shall be designed for mounting directly to damper shaft without need for connecting linkages.
4. Self-Centering Capability: Actuators having more than 100-lb-in torque output shall have a self-centering damper shaft clamp that guarantees concentric alignment of actuator's output coupling with damper shaft. Self-centering clamp shall have a pair of opposed "V" shaped toothed cradles, each having two rows of teeth to maximize holding strength. A single clamping bolt shall simultaneously drive both cradles into contact with damper shaft.
5. Shaft Size: Actuators having more than a 100-lb-in torque output shall accept a 1.00-inch-diameter shaft directly, without need for auxiliary adapters.
6. Certifications: Actuators shall be designed and manufactured using ISO 9000 registered procedures, and shall be listed under Standards UL 873 and CSA C22.2 No. 24-93 1.
7. Failure: Unless otherwise required or indicated by control sequence, damper actuator shall fail in place.

D. Automatic Control Valves:
   1. Modulating Type:
      a. Valves shall be provided with equal percentage contoured throttling plugs. Three-way valves shall be provided with linear throttling plugs such that total flow through valve remains constant regardless of valve position.
      b. Unless otherwise specified, control valves 1.00 inch and smaller shall be ball type and control valves over 1.50 inches shall be globe type. Control valves 2.00 inches and smaller shall be brass or bronze, with threaded ends. Bodies for valves 2.50 inches and larger shall have flanged end connections and body material shall be cast iron or carbon steel. Grooved end valves may be used in grooved piping systems.
      c. Valve Cv shall be within 100 to 125 percent of calculated Cv. Valves shall provide effective control at pressure differential at full pump head psig. Pressure drop shall not exceed 5 psig at maximum flow rate for hydronic systems.
      d. Valves shall be capable of withstanding maximum operating pressures and temperatures of controlled medium with tight shut-off capability. Minimum valve body pressure rating shall be 125 psig or 150 percent of system operating pressure, whichever is greater. Valve leakage rating shall be a maximum of 0.01 percent of rated Cv at a differential pressure of 50 psig or 125 percent of that expected for application, whichever is greater.
      e. Valves controlling steam with an inlet pressure of 25 psig or greater shall be equipped with stainless steel trim.
      f. Actuators shall be selected to close valve under flow conditions against 150 percent of normal control medium operating pressure differential.
      g. Unless specified to fail to "normally open," "normally closed," or as otherwise indicated by control sequence, electric control valve actuators shall fail in place. "Normally open" and "normally closed" designations on Drawings refer to fail-safe valve position whenever normal control power is interrupted. Valves larger than 6.00 inches shall have electric actuators provided with battery back-up to return or maintain valve to specified fail-safe (normally open or normally closed) position as shown or specified, whenever normal control power is interrupted.
   2. Modulating Ball Valves:
      a. Modulating ball valves are acceptable for valves 1.00 inch or less. Valve body shall be forged brass with 300 Series stainless steel ball, NPT end connections, blowout-proof stem with 300 Series stainless steel. Actuators shall be selected to

close valve under flow conditions against 150 percent of normal control medium operating pressure differential.

b. Provide valve seats with graphite reinforced PTFE and EPDM O-ring backing, stem seals with EPDM double O-rings, and bubble-tight leakage rating per ISO-5208.

c. Valve assembly shall be maintenance free with no packings to adjust, no periodic rebuilding, and performance rating in excess of 200,000 full stroke cycles in iron oxide contaminated water without failure.

3. Modulating High Performance Butterfly Valve (HPBV):
   a. Valves shall be of eccentric disk design with near linear flow characteristics.
   b. Valve bodies shall be carbon steel; Class 150 temperature and pressure ratings per ASME B16.34.
   c. Seals shall be polytetrafluoroethylene (PTFE).
   d. Flow coefficient ratio 100:1.
   e. Diaphragm actuator with positioner and indicator.
   f. Horizontal mount with shaft downstream of disk.
   g. Manufacturer and model number: Fisher 8560.
4. Valves for Chilled Water and Condenser Water: Internal valve trim shall be bronze, except that valve stems may be Type 316 stainless steel.
5. Valves for Hot Water Service Below 210 degrees F: Internal trim shall be brass or bronze.
6. Valves for Hot Water Service Above 210 degrees F: Internal trim (including seats, seat rings, modulating plugs, and springs) shall be Type 316 stainless steel.
7. Valves for Steam Service: Bodies for valves 4.00 inches and larger shall be iron. Internal valve trim shall be Type 316 stainless steel. Steam valves shall have linear characteristics.
8. Butterfly Valve Assembly: Assembly shall be threaded lug type for dead-end service and shall shut to fully closed position. Valves shall have carbon steel bodies and non-corrosive discs, stainless steel shafts supported by bearings, and elastomeric renewable seats for temperatures from minus 20 to plus 250 degrees F. Valves shall have a manual means of operation independent of actuator. Provide butterfly valves for applications such as cooling tower bypass, isolation, and diverting.
9. Electric Valve Actuators:
   a. Valves larger than 0.75 inches shall be provided with valve stem travel indicators as a means of indicating position of valve.
   b. Reheat terminal control valves shall be normally open.
10. Two-Position Type: Full line size threaded lug type butterfly valve, full line size two-piece ball valve, or modulating type valve as specified above with a maximum pressure drop at design flow of 1 psig. Valves shall be capable of withstanding maximum operating pressures and temperatures of controlled medium with tight shut-off capability. Minimum valve body pressure rating shall be 125 psig. Actuators shall be selected to close valve under flow conditions against 150 percent of normal control medium operating pressure differential. Valves shall be provided with an externally visible means of position indication. Normally open and normally closed designations on Drawings refer to valve position under normal operating conditions.
11. Thermostatic Radiator Valves: Valves shall be straight pattern type with temperature rating of 250 degrees F. Valve shall have maximum/minimum temperature limit lock and operator. Temperature sensing element shall be either self-contained for use inside of buildings or remote with capillary tube for use in utilidors. Capillary tube length shall be a minimum of 10.00 feet. Knob type dial shall be provided for temperature setting. Temperature graduation shall be manufacturer's standard. Minimum adjustable temperature differential shall be 15 degrees F. Valve body shall be nickel-plated brass or stainless steel. Connection shall be screwed NPT type. Operator body and other parts materials shall be compatible for application temperature, pressure, and fluid environment.
12. Manufacturer: Valves shall be manufactured by Belimo, Johnson Controls, Siemens, or Invensys.

E. Automatic Control Dampers (ACD):
   1. General: Individual damper blades shall be a maximum of 6.00 inches wide and/or 4.00 feet long. Edge seals for 0 to 180 degrees F operating temperatures. Blade linkages shall be attached at midpoint of blade length. Provide actuators for application. Provide one actuator for every 20.00 square feet of damper. Actuators shall utilize spring return on outside air applications. Provide positioning relays on pneumatic actuators to stroke damper(s) properly (i.e., sufficient power, sequencing, repeatability, or speed of response). Standard dampers shall be Ruskin CD36, butterfly dampers shall be Ruskin CDRS25, and low-leakage dampers shall be Vent Products 5900, or reviewed products provided by Vent Products, Air Balance, Johnson Controls, or Honeywell. Actuators shall be manufactured by Johnson Controls, Belimo, Siemens, or Invensys.
   2. ACD – Standard Modulating Type: Opposed blade type unless indicated otherwise. Blades and internally braced frames shall be constructed of 16 gauge-galvanized steel. Blades shall be equipped with 0.50-inch minimum thickness axles, molded synthetic bearings, EDPM or vinyl edge seals, and a flexible aluminum or stainless steel compression type jamb seal. Leakage shall not be greater than 7 CFM per square foot at 1.00-inch static pressure difference, regardless of damper size. Damper shall have a maximum operating static pressure differential of 2.00 inches. Unless indicated otherwise, dampers shall be sized for a maximum pressure drop of 0.10 inches at maximum design airflow.
   3. ACD – Standard Two-Position Type: Parallel blade type with construction and performance same as specified for modulating type. Unless indicated otherwise, dampers shall be same size as duct. Where dampers are not provided in a duct, dampers shall be sized for a maximum pressure drop of 0.05 inches at maximum design airflow.
   4. ACD – Butterfly Two-Position Type: Single round butterfly blade consisting of two layers of galvanized steel with a neoprene edge seal sandwiched between them. Frame shall be constructed of 20-gauge galvanized sheet steel and have a smooth interior air stream surface with no projections. Frames shall have rolled stiffener beads to facilitate sealing of a slip on a duct connection. Blade shall be equipped with a 0.50-inch minimum diameter axle with stainless steel sleeves for bearings. Leakage shall not be greater than 0.15 CFM per inch of blade circumference at 4.00-inch static pressure difference. Unless indicated otherwise, dampers shall be same size as duct. Where dampers are not provided in a duct, dampers shall be sized for a maximum pressure drop of 0.05 inches at maximum design airflow.
   5. ACD – Low-Leakage Modulating Type: Opposed blade type unless indicated otherwise. Internally braced frames shall be constructed of 16-gauge galvanized steel. Airfoil blades shall be equipped with 0.50-inch minimum thickness axles, stainless steel or bronze sleeve bearings, field replaceable EDPM or vinyl edge seals, and a flexible aluminum or stainless steel compression type jamb seal. Leakage shall not be greater than 10.5 CFM per sq ft at 4.00-inch static pressure difference, regardless of damper size. Damper shall have a maximum operating static pressure differential of 6.00 inches and be capable of operating with face velocities up to 3,000 fpm. Unless indicated otherwise, dampers shall be sized for a maximum pressure drop of 0.10 inches at maximum design airflow.
   6. ACD – Low-Leakage Two-Position Type: Parallel blade type with construction and performance same as specified for low-leakage modulating type. Unless otherwise indicated, dampers shall be same size as duct; where dampers are not provided in a duct, dampers shall be sized for a maximum pressure drop of 0.05 inches at maximum design airflow.
   7. Damper End Switches: Damper end switches shall be momentary type limit switches for monitoring motion of damper at a prescribed arc of rotation. Switch shall be hermetically sealed mercury contacts that operate by way of a trip lever. Switch shall be mounted on exterior of duct so that trip lever is aligned with damper vane. Mechanical adjustments in switch case shall permit lever action for tripping mercury switch contacts. Switch shall have a SPDT contact arrangement that exceeds load requirements for both voltage and current.

F. Pressure Sensors:
   1. Air Differential Pressure Switches: Diaphragm actuated switch with adjustable setpoint fixed differential, automatic reset, and angle tipped static pressure probes. Range of switch to accommodate operating range of system being monitored plus and minus 20 percent, 12.00-inch maximum operating differential.
   2. Filter Differential Pressure Sensors: Provide a differential pressure sensor that shall sense a change in differential pressure drop as airflow across filter changes. Provide adjustable software setpoint for alarm.
   3. Pressure Safety Switches: Provide static pressure high limit and low limit switches as required by sequence of operation to sense duct over-pressure or under-pressure condition. Provide with adjustable setpoint. Provide with spare contacts for monitoring by control system. Provide switch for duct mounting. Dwyer or Ashcroft.
   4. Fluid Differential Pressure Switch:
      a. Pipe in parallel across water circuit pumps for positive indication of flow. Diaphragm operated snap action SPDT switches shall operate from a neoprene slack diaphragm, corrosion-resistant stainless diaphragm, or copper diaphragm capable of being adjusted through total pressure range. Switches shall withstand at least twice system working pressure, including standing head, and have a temperature range exceeding worst-case liquid and ambient conditions. Provide a NEMA 4 enclosure for switch assembly. For ease of service and maintenance, provide switch with a three-valve manifold piped in copper to pressure taps in liquid lines. Provide with spare contacts for monitoring by control system.
      b. Manufacturer: Penn P74.
   5. Water Differential Pressure Transmitters:
      a. Provide water differential pressure transmitters constructed to withstand 100 percent pressure over range without damage, and to hold calibrated accuracy when subject to a momentary 40 percent over range input.
      b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA linear output signal proportional to change in pressure. Provide NEMA 4 housing for transmitter.
      c. Parts in contact with water shall be stainless steel and elastomer seals. Provide a three-valve manifold assembly to protect against excessive differential overpressure. Transmitters shall be located in accessible local control panels wherever possible. Zero and span adjustment. Operating range of 0 to 25 psig. Accuracy of plus or minus 2 percent or full-scale reading.
   6. Building Differential Pressure Transmitters:
      a. Building differential pressure transmitters shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressuring sensing points. Differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from outside cover and meet following performance specifications:
         1) Minus 1.00 to plus 1.00 w.c. input differential pressure ranges. (Select range for system application.)
         2) 4 to 20 mA output.
         3) Maintain accuracy up to 20 to 1 ratio turndown.
         4) Reference Accuracy: Plus or minus 0.25 percent of full span.
      b. Manufacturer: Veris or Setra.
   7. Duct Differential Pressure Transmitters:
      a. Duct differential pressure transmitters shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points. Differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from outside cover and meet following performance specifications:
         1) 1.00 inch to 5.00 inches w.c. input differential pressure ranges. (Select range for system application.)

2) 4 to 20 mA output.
3) Maintain accuracy up to 20 to 1 ratio turndown.
4) Reference Accuracy: Plus or minus 0.25 percent of full span.

b. Manufacturer: Veris or Setra.

8. Velocity Sensors: Velocity sensor shall be used to measure differential pressure to determine air velocity for calculating airflow in VAV terminal units. Sensor shall measure differential pressure and generate a proportional voltage signal. Voltage signal shall be read by VAV controller and converted to airflow in cubic feet per minute (CFM). Calibration shall be performed within controller. Pressure range 0 to 1.50 inches w.c. maximum overpressure limit 15.00 inches w.c. Accuracy linearity 1.0 percent full span maximum. Repeatability/ hysteresis 0.05 percent full span maximum. UL 916 listed.
9. Pressure Electric (PE) Switches: Provide with adjustable setpoint and differential range.
10. Liquid Flow Switch:
    a. Paddle type, 150 psig maximum working pressure, and flow actuation sensitivity for application.
    b. Manufacturer: Johnson Controls or Penn F61 Series.

G. Gas Sensors:
1. CO2 Sensors: Provide an electronic sensor to monitor amount of CO2 in air in range of 0 to 2,000 parts per million (ppm) for duct or wall mounting. Measuring principal shall be based on infrared spectroscopy or non-dispersive CO2 sensing technology. Internal electronics shall require a 24 VAC power supply and shall calculate CO2 concentration in return air or space. Provide 0 to 10 VDC or 4 to 20 mA output signal, which corresponds linearly to 0 to 2,000 ppm of CO2 for use in optimization of mixing dampers and economizer control. Provide activation of an adjustable contact closure relay when user defined CO2 levels are reached for alarm. CO2 sensors shall be certified by manufacturer to have an accuracy of no less than 75 ppm, factory calibrated or calibrated at startup, and certified by manufacturer to require calibration no more frequently than once every five years.
2. Air Quality Sensors:
    a. Provide full spectrum air quality sensors with filters utilizing hot wire element based on Taguchi principle. Sensors monitor a wide range of gaseous organic materials, which are common components of indoor air contaminants. These gaseous materials include paints and solvents, cooking and cigarette smoke, and car exhaust.
    b. Sensors shall compensate for temperature and humidity, have span and calibration potentiometers, operate on 24 VDC power with output of 0 to 10 VDC, and operate between 32 and 140 degrees F and 5 to 95 percent RH. Provide isolation power supply for each sensor.
3. CO Sensors:
    a. Provide sensors with tamper-proof steel housing for mounting in parking garage area where indicated on Drawings. Sensing element shall be solid state with metal oxide semiconductor element. Signal from element shall be measured by a built-in microprocessor, preprogrammed with a Time Weighted Average/Threshold Limit Value (TWA/TLV) to energize fan and alarm relays. TWA/TLV shall be set at 35 ppm of CO averaged over five minutes for fan activation and 100 ppm after 30 minutes or 200 ppm after 10 minutes for alarm relay activation. Unit shall be self-calibrating and have a self-test cycle of at least 2.5 minutes. Unit shall also have ability to operate fans for a minimum of 2.5 minutes when main power is restored after a power failure. Unit shall have internal continuous monitoring for malfunction and upon detecting a malfunction, fan shall be activated to ensure a safe environment. Unit shall have display indicating system status. Sensor shall be powered by 24 VAC.
    b. Manufacturer: Macurco Model CM-21A.
4. Oxygen Depletion Sensor: Oxygen sensor shall monitor oxygen levels and report alarm in event of oxygen depletion due to a refrigerant leak. Provide 4 to 20 mA or minus 10 VDC output and an SPDT relay output to ATCS. Range 0 to 25 percent oxygen, 12-second response time.

5. Power Metering:
    a. Provide electric utility meter 3-phase monitoring, diagnostics, and energy reports of consumption, demand, and power quality.
    b. Meter shall include input primary voltage of 120 to 480 VAC, Single and 3-phase monitoring, maximum primary current of 2,400 amps per phase, split core current transformer, and accuracy of IEC 62053-22 Class 0.5S, ANSI C12.20 0.5%.
    c. Power monitoring data shall include:
        1) kWH consumption.
        2) kW demand.
        3) VAR reactive power.
        4) VA apparent power.
        5) Power factor.
        6) Average, minimum, and maximum demand.
        7) Voltage, line-to-line and line-to-neutral.
        8) Amps, average current.
        9) kW demand (each phase).
        10) Power factor (each phase).
        11) Voltage (each phase).
        12) Amps (each phase).
    d. The power meter shall communicate using the BACnet MS/TP protocol at speeds from 9600 to 76,800 baud (no parity). The meter shall provide a BACnet Device object, a set of writable Analog_Value objects for remote configuration, a set of Analog_Input objects to provide access to scaled 32-bit measurement values and their unit types, and a set of Binary_Input objects for indicating individual alarm conditions.
    e. The meter shall be UL/CUL listed to the latest applicable safety standards.
    f. The power meter shall accept either 0 to 0.333VAC or 0 to 1VAC input from up to three current transducers to 5,000 amps.
    g. The power meter shall be configurable for operation on Single Phase (AN or AB), Split Phase (ABN), Delta (ABC), and Wye (ABCN) systems.
    h. Products
        1) Veris E50 Series
        2) Setra Power Patrol
        3) Or Reviewed
6. Energy Metering Data:
    a. The energy metering system shall monitor the following Total Building Energy Sources:
        1) Electric
        2) District Energy
        3) Site-Generated Renewable Energy
    b. The energy metering system shall monitor the following End Use Categories:
        1) HVAC System Energy
        2) Water Heating Energy
        3) Lighting Energy
        4) Plug Load Energy
        5) Process Load
7. Energy Metering Data Acquisition System
    a. The energy meter data shall be stored for a minimum of 36 months.
    b. The energy metering data acquisition system shall provide real-time energy consumption data and logged data for any hour, day, month, or year.
    c. A readily accessible and visible display, or a web page, or other electronic document accessible to the building management or to a third-party energy data analysis service shall be provided in the building accessible by building operation and management personnel.

d. The energy display shall graphically provide the current energy consumption rate for each Total Building Energy Source and each End Use Category.
e. The energy display shall display the average and peak values for any day, week, or year.

8. Current Sensing Relay: Provide 100 percent solid state with adjustable range (plus or minus 1 percent of range) trip setpoint to monitor AC current. Provide with contact transfer with no calibration drift, complete with LED status indicator. Limit off state leakage to 2 mA or less. Rating (200-ampere minimum) shall exceed equipment being monitored.
9. Current Sensors: Sensors shall vary output voltage proportional to change in sensed current. Multiple range units shall be provided to allow for varying site conditions. Low range units shall offer ranges of 10, 20, and 50 amps. High range units shall offer ranges of 50, 100, and 200 amps. Provide actual analog current indication for status of motors 1 horsepower and larger. Provide switch points to determine motor status in software.
10. Occupancy Sensors: Provide ceiling- or wall-mounted passive infrared occupancy sensor as shown on Drawings. Provide isolated relay for input to BAS, user adjustable time delay (30 seconds to 30 minutes), user adjustable sensitivity, 360-degree coverage up to 1,200 square feet, and red LED to indicate occupancy detection. Include power supply, power packs, relays, and enclosures.
11. Photo Sensor: Provide photo sensor to indicate presence or absence of light at sensor location. Provide with 4 to 20 mA transmitter for input to BAS. Include weatherproof enclosure, power supply, and accessories.
12. Window Proximity Sensor: Provide sensor designed to detect open/close status of operable windows. Sensor shall contain a hermetically sealed magnetic read switch. Switch shall be low profile surface mount terminal, 2.00 inches long by 0.375-inch maximum height. Magnet shall be rare earth washer type, maximum height of 0.125 inch. Maximum operational distance between magnet and proximity switch shall be 2.00 inches. Switch shall be mounted on inside face of stationary mullion. Magnet shall be mounted on inside of operable window mullion. Magnet shall be aligned with either end of proximity switch. Sentrol Model 1138T or equivalent.
13. Three-Phase Voltage Monitor:
    a. Provide voltage monitor to protect against phase loss, phase unbalance, phase reversal, and undervoltage conditions. Relays shall be provided with components for a complete installation including control relays, control transformers, and NEMA enclosures.
    b. In event of an electrical power phase loss, phase unbalance, under or overvoltage, or phase reversal, connected mechanical equipment shall be shut down within a 15-second period and an alarm requiring acknowledgement shall be generated at operator’s terminal.
    c. Signal is provided to EMCS system from a power system monitor relay connected to main distribution switchboards. Voltage monitor relay shall include adjustable time delay and visual trip indicators, and shall be automatically reset. Following restoration of power and a one-minute time delay, mechanical equipment shall be sequentially started to avoid power surges. Date and time of occurrence and restoration shall be printed on EMCS printer. Voltage sensing taps shall be ahead of branch disconnects and shall be individually fused with current limiting fuses. Coordinate installation with Electrical Contractor.
14. Natural Gas Meter Monitoring: Provide hardware, software, and wiring for interfacing with gas company building natural gas meter.
15. BTU Meter:
    a. Provide BTU meter in hot water supply for computing thermal energy use and sub-metering applications. BTU meter shall measure liquid flow rate and hot water supply and return temperatures, and calculate energy being consumed. Provide local wall-mounted display of energy rate, temperature, energy total, or flow rate. Provide

material for hot tap installation. Display following information at operator workstation in a dedicated graphic display:
1) Real-time flow rate.
2) Flow total.
3) Hot water supply and return temperatures.
4) Energy rate.
5) Total energy.

16. Electromagnetic Flow Meter:
    a. General: Sensor shall be an electromagnetic flow meter that utilizes Faraday's Law to measure volumetric fluid flow through a pipe.
    b. Flow meter shall consist of two elements, sensor and electronics. Sensor shall generate a measuring signal proportional to flow velocity in pipe. Electronics shall convert an EMF into a standard current output.
    c. Manufacturer and Model Number: Siemens Model MAG 3100 electromagnetic meter with Model MAG 5000 electronic transmitter and display.
17. Pitot Tube Flow Sensor: Provide pitot tube type flow sensor with accuracy of plus or minus 1 percent over a 10 to 1 turndown. Dieterich Standard Annubar Flow Sensor Models DNT and DCR with eagle eye gpm gauge.

H. Airflow Measuring Unit:
1. General: Airflow and temperature measuring unit (AMU) indicated on plans shall be capable of monitoring airflow and temperature rates at each measurement location. System shall be factory tested prior to shipment and shall not require calibration or adjustment over life of equipment when provided in accordance with manufacturer's guidelines. Each sensor probe shall be provided with a UL plenum-rated connecting cable. Connecting cable shall be a minimum of 10.00 feet in length for each probe. No additional devices or transducers shall be required to interface with host controls.
2. Sensors: Sensors shall be calibrated to NIST-traceable standards for both airflow and temperature. Each sensing point shall independently measure airflow and temperature prior to averaging. Provided accuracy shall be percent of reading and demonstrated at both maximum and minimum airflow rates for each measurement location.
3. Transmitter and Electronics Enclosure: Transmitter shall operate on 24 VAC. Transmitter shall have a minimum 16-character alphanumeric LCD display for airflow, temperature, and system diagnostics. Analog output signals shall be user selectable (0 to 10 VDC or 2 to 20 mA). When required, a serial RS-485 interface shall be made available with network protocols of either N2 or Modbus RTU, as required by DDC control equipment. Inputs and outputs shall be fused, protected, and internally isolated from 24 VAC power supply. Transmitter shall have a non-drifting adjustment for output signal offset/gain. Transmitter display shall be capable of being configured in either I.P. or S.I. units. Transmitter shall accept a user-defined area to display volumetric flow rates in CFM or LPS. Enclosure shall be aluminum alloy for indoor use and capable of operating over a temperature range of 30 to 120 degrees F. Where electronics are provided in locations subject to weather or high humidity (above 75 percent), provide in a NEMA 4 enclosure.
4. Duct- and Plenum-Mounted Sensor Probes:
    a. Sensor probes shall be constructed of anodized aluminum alloy tube with stainless steel mounting brackets. Probes shall be constructed to provide insertion, internal, or standoff mounting, depending on applications and field installation requirements.
    b. Sensor accuracy for airflow shall be no more than plus or minus 2 percent of reading over sensor probe operating ranges. Provided total accuracy for airflow shall be better than plus or minus 3 percent of reading over sensor probe operating ranges when provided in accordance with manufacturer's guidelines. Sensor accuracy for temperature shall be better than plus or minus 0.15 degrees F over entire operating range. Each sensing point shall independently measure airflow and temperature prior to averaging.

c. Number of independent sensing points shall be distributed per duct face area, at a minimum quantity as indicated below:

A□□□ (□□ □)	**A□□□ (□□ □)**	**S□□□□□**
≤ 1	≤ 0.093	2
1 to 4	0.093 to 0.372	4
4 to 8	0.372 to 0.743	6
8 to 12	0.743 to 1.115	8
12 to 16	1.115 to 1.486	12
≥ 16	≥ 1.486	16

d. Probe Operating Ranges:
   1) Airflow: 0 to 5,000 fpm.
   2) Temperature: Minus 20 to plus 160 degrees F.
   3) Relative Humidity: 0 to 99 percent (non-condensing).

5. Fan Inlet Velocity Sensors: Sensors shall be totally constructed from non-corrosive materials, with stainless steel sensor bodies, stainless steel mounting brackets, and adjustable cadmium-plated mounting rods.
   a. Fan Inlet Performance Requirements: Individual sensor accuracy for airflow shall be better than plus or minus 3 percent of reading over sensor probe operating ranges when provided in accordance with manufacturer's guidelines. Provided accuracy for temperature shall be better than plus or minus 0.15 degrees F over entire operating range.
   b. Fan Inlet Sensor Operating Ranges:
      1) Airflow: 0 to 10,000 fpm.
      2) Temperature: Minus 20 to plus 160 degrees F.
      3) Relative Humidity: 0 to 99 percent (non-condensing).
6. Dynamic Pressure "Bleed Flow" Sensors: Each sensing point shall independently measure bleed airflow rates and direction, or dynamic differential pressure, plus temperature.
   a. DP Sensor Performance Requirements: Provided total accuracy for airflow shall be better than plus or minus 2 percent of reading and plus or minus 4 percent of reading for pressure over sensor operating range when provided in accordance with manufacturer's guidelines. Provided accuracy for temperature shall be better than plus or minus 0.15 degrees F over entire operating ranges. Sensors shall be calibrated to NIST-traceable standards for airflow and temperature.
   b. DP Sensor Operating Ranges:
      1) Bleed Airflow: Minus 2,000 fpm to plus 2,000 fpm.
      2) Differential Pressure: Minus 0.25-inch w.g. to plus 0.25-inch w.g.
      3) Temperature: Minus 20 to plus 160 degrees F.
      4) Relative Humidity: 0 to 99 percent (non-condensing).
7. Manufacturers and Equipment:
   a. EBTRON Gold Series probes, combination airflow/temperature sensors plus associated transmitters.
   b. Tek-Air Model Vortek, vortex shedding probes and matching electronics with display, mated with conforming multi-point temperature sensors.
   c. Air Monitor VoluProbe, supplied with Veltron II (0.1 percent FS) transmitters and mated with conforming multi-point temperature sensors.

I. Air Static Pressure Sensing Probe:
Provide full width duct traverse, extruded aluminum probe, with multiple sensing ports. Air Monitor Model Stat-Probe/1. Outside air static pressure sensing probe shall consist of two circular, parallel, 10-gauge anodized aluminum plates with a 2.00-inch FPT connection. Sensor shall be accurate to within 2 percent of actual ambient pressure when subject to radial wind velocities up to 80 miles per hour with approach angles up to 30 degrees to horizontal. Air Monitor model S.O.A.P.

J. Airflow Switch:
For control and monitoring of airflow in ducts and designed for duct mounting. Airflow switch shall have following characteristics:
1. Rating: NEMA 1 construction.
2. Construction: Stainless steel paddle.
3. Switch: On/Off single stage micro switch.
4. Voltage: 24 VAC.
5. Adjustability: Adjustable for sensitivity and flow rate.
6. Manufacturer/Model: Intec Controls, Model DBSL.

K. Damper Position Indicator Switch:
Designed for use with a control damper, smoke damper, or fire/smoke damper to remotely indicate blade position of a two-position damper (open or closed). Switch shall positively communicate position of damper blades when interfaced with an associated device, control point, or operating equipment. Ruskin Model SP100.

L. Miscellaneous Devices:
1. Bypass Timer: 0- to 6-hour dial type electromechanical timed switch. Intermatic.
2. Duct Smoke Detector: Standalone, sampling photoelectric type for sensing of products of combustion within air stream of ducted fan systems. Devices shall include sampling tube extensions and sensitivity adjustments for detecting products of combustion across width of duct. Device shall function uniformly in air velocities of 400 fpm through 3,000 fpm. Voltage shall be 24 VDC or 120 VAC. Include two sets of auxiliary contacts rated for 12 amps resistive with manual reset. Visual indication of normal and alarm/trouble conditions shall be incorporated into exposed surface of device.
3. Control Power Transformers:
    a. BAS Contractor shall be responsible for providing control power sources and wiring for specified sequence of operation.
    b. Transformers shall be UL listed, provided with primary and secondary overcurrent protection, and sized in accordance with NEC Article 725. Control power transformers shall be sized to accommodate an additional 25 percent load (minimum) for future devices.
    c. Where packaged mechanical equipment is specified to be provided with a control power transformer, this power source shall not be utilized for devices added under this scope of work unless prior review, in writing, is obtained from Owner's Representative.
    d. Provide each transformer with a resettable circuit breaker. Circuit breakers shall be trip-free.
4. Control Relays: Rated for application with a minimum of two sets of Form C contacts enclosed in a dustproof enclosure. Relays shall be rated for a minimum life of one million operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to 150 percent of rated coil voltage.
5. Control Panels and Enclosures:
    a. Control panels for controls and instruments shall be UL listed NEMA enclosure rate for application, surface or flush-mounted panel as indicated, with key locked continuous-hinge door. Panel assemblies shall be UL 508 listed.
    b. Provide enclosures for auxiliary control devices such as relays, transformers, solenoid valves, etc. Enclosures shall be hinged and key locked.
    c. Keys shall be same keys used for other panels and enclosures on Project. Manufacturer's standard baked enamel finish.
6. Electronic/Pneumatic Transducers:
    a. Provide electronic to pneumatic pressure transducers to convert digital analog signal to variable-to-variable pneumatic air pressure signal. Units to have following characteristics:
        1) Output: 3 to 15 psig.

2) Input: 4 to 20 mA or 0 to 10 VDC.
3) Manual output adjustment knob.
4) Pressure gauge.
5) External replaceable supply air filter.

7. Horns: Horns shall be electromechanical vibration of diaphragm type. Diaphragm material shall be stainless steel. Area audible alarm shall provide at least 85 dB at 10.00 feet from device. Provide exterior devices for area classification where they are located. Minimum enclosure shall be watertight/dust tight. Horn shall be operated with 120 VAC power supply.
8. Warning Lights: Visual warning devices shall be incandescent indicating lights of at least 123 candlepower. Exterior devices shall be designed for wet locations or rated weatherproof unless indicated otherwise. Warning lights shall be operated with 120 VAC power supply. Lens shall be yellow.
9. Manual Start/Stop Station:
   a. Key-operated three-position toggle switch in flush enclosure with stainless steel cover. 3 amperes at 25 VAC.
   b. 120 V Solid State Speed Controller: Lutron Nova Series variable speed fan control.
   c. Manual Toggle Switch: Line voltage 120 V manual starter with pilot light and flush mount enclosure.
10. Terminal Unit Transformers (VAV, CV, and CAV Terminals):
    a. Provide Class II, 24 V transformers within a standalone control cabinet for providing power to terminal units. Each control cabinet to house a maximum of six transformers. Each transformer to provide 24 V control power to a maximum of five terminal units. Contractor to determine number of control cabinets and transformers required based on terminal unit schedules.
    b. Contractor to provide 24 V wiring between transformers and terminal units. See terminal unit schedule on Drawings.
    c. Manufacturer and Model:
       1) Control Power Transformers: Equivalent to Core Components, Inc. LE 120.
       2) Control Cabinets: Equivalent to Siemens Powers Controls CP 567.

PART 3 EXECUTION

3.01 PROJECT MANAGEMENT

A. General:
Provide a designated Project Manager who shall be responsible for following:
1. Schedule: Construct and maintain Project schedule.
2. Onsite Coordination: Coordinate with trades, subcontractors, and other integration vendors authorized to accept and execute orders or instructions from Owner’s Representative.
3. Project Meetings: Attend Project meetings to avoid conflicts and delays.
4. Field Work: Make field decisions relating to this scope of work.
5. Contact Person: Provide coordination/single point of contact.

3.02 SEQUENCE OF OPERATION

A. General:
Provide a complete and operational temperature control and building automation system. System shall have complete sequences and standard control practices. Point list is minimum amount of points that are to be provided. If additional points are required to meet sequence of operation, they shall be provided.

B. Sequence of Operations:
See sequence of operations on Drawings.

3.03 STARTUP AND COMMISSIONING

A. General:
When installation of system is complete, calibrate equipment and verify transmission media

operation before system is placed online. Testing, calibrating, adjusting, and final field tests shall be completed by manufacturer. Verify that systems are operable from local controls in specified failure mode upon panel failure or loss of power.

B. System Modifications:
Provide recommendation for system modification in writing to Owner. Do not make system modification, including operating parameters and control settings, without prior review of Owner.

C. Commissioning of Integrated System Segments:
After manufacturer has completed system start-up and commissioning, joint commissioning of integrated system segments shall be completed.

3.04 ELECTRICAL WIRING AND MATERIALS

A. General:
System shall be provided in a neat and competent manner by experienced and trained technicians either in direct employ of system manufacturer or under manufacturer's direct supervision. Provided system shall be delivered to Owner completed and fully operational.
1. Manufacturer's Instructions: Provide equipment in accordance with manufacturer's instructions and published application literature.
2. Electrical Power Wiring: Electrical power wiring provisions for BAS shall be provided to locations indicated on electrical plans by electrical sections of this Project Specification. BAS supplier shall provide additional power requirements for BAS components that are not indicated on electrical plans. Provide control power circuits from electrical panels. Provide additional circuit breakers rated and labeled for service. Unless reviewed by Electrical Engineer, spare breakers shall not be used. Coordinate with Electrical Contractor.
3. Other Electrical Work: All other electrical work for BAS, including power wiring that is not shown on electrical plans, shall be responsibility of this BAS supplier, including interlock wiring described in Sequence of Operation. Control wiring, conduit for control wiring, and miscellaneous accessory equipment for control wiring systems shall be provided by BAS supplier as part of control system. Conform to electrical sections of this Project Specification, NEC, NFPA 70, and local code requirements.

B. Electrical Installation Methods:
1. Wiring: Wiring in or through mechanical rooms, finished spaces, on roofs, in walls, below grade, inside equipment, and in concealed inaccessible locations, shall be provided in conduit and properly supported, unless indicated otherwise. Local area network communication wiring between operation workstations and global controllers shall be in conduit. Label wire groups to match corresponding wiring diagrams. Wiring within control panels may be provided separate from raceway. Wiring above accessible ceilings may be plenum cable provided separate from raceway as described in Paragraph 3.
2. Plenum Cable:
   a. Plenum cable shall be allowed for use only in accessible ceiling spaces for:
      1) Second tier standalone DDC communication trunk serving application-specific controllers within a building.
      2) DDC system sensor wire provided above suspended accessible ceilings.
   b. Plenum cable type, installation methods, and use shall be subject to city and state codes and regulations. Within ceiling space, attach directly to wall or slab on 4.00-foot centers, or support from ceiling suspension wires on 4.00-foot centers. Do not attach cables to pipes or ducts, or lay on ceilings. Cables shall be routed to maximize ceiling space without interfering with equipment, ceiling, lighting access, and removal.
3. Raceways: Raceways shall be run parallel or perpendicular to building structure, ceiling, and floor, and shall be secured and supported. Raceways connected to equipment mounted to or on vibrating machinery (such as fans, ducts, pumps, or pipes) shall be isolated by use of short (1.00 inch or less) pieces of flexible "greenfield" conduit, unless duct or pipe itself is sufficiently vibration isolated to eliminate transmission.

4. Instrumentation and Communication Cable: Cables shall not be run together in same conduit or raceway as power wiring.
5. Communication Cable: Provide communication wiring panels between operator workstation and standalone DDC panels and between standalone DDC panels and application-specific controllers such as AHU, unitary, or VAV digital controllers. Communication cable shall be checked for continuity, grounding, and shielding. Local area network communication wiring between operator workstations and global controllers shall be in conduit.
6. Ethernet: Connect BAS to Owner's Ethernet network. Provide Ethernet fiber, hub, and hub connections.
7. Control and Alarm Wiring: Provide wiring between thermostats, and control and alarm devices.
8. Conduit and Signal Wiring: Provide conduit and signal wiring between motor starters in motor control centers and high and/or low temperature relay contacts and remotes relays in BMS panels located in vicinity of motor control centers.
9. Other Conduit and Wiring: Provide conduit and wiring between PC workstation, electrical panels, metering instrumentation, indicating devices, miscellaneous alarm points, remotely operated contactors, and BMS panels, as shown on Drawings or as specified.
10. Wall-Mounted Devices: Provide electrical wall box and conduit sleeve for wall-mounted devices. Room CO2 sensors shall be provided at same elevation as room thermostat. Confirm location with Architectural elevations.
11. Ceiling Plenum: Provide conduit between wall-mounted wall box and ceiling plenum. Provide 90-degree elbow into ceiling plenum.
12. Interface Control Wiring: Provide interface control wiring for equipment with remote sensors, panels, limits, and components to serve specified control functions. Materials, wiring, and termination shall be provided in accordance with manufacturer's instructions. Provide interface control wiring of following equipment:
    a. Heat pumps: Flow switches, temperature sensors, and remote control panels. Provide and locate refrigerant vapor detection and alarm systems in compliance with Uniform Fire Code Section 53.11.
    b. AC Unit: Temperature and humidity sensors and control panels.
13. Grounding: Ground controllers to a good earth ground. Grounding of green AC ground wire at breaker panel alone is not adequate. Run metal conduit from controller panels to building grounds. Ground sensor drain wire shields at controller end. Associated ground loop problems shall be corrected.

C. Surge Protection:
1. General: Provide surge and transient protection consisting of devices provided externally to operator workstations.
2. Power Line Surge Protection: Surge suppressors external to workstation shall be provided on incoming AC power. Surge suppressor shall be rated by UL 1449 and have clamping voltage ratings below following levels:
    a. Normal Mode (Line to Neutral): 350 V.
    b. Common Mode (Line to Ground): 350 V.
3. Telephone and Communication Line Surge Protection: Metal oxide varistor (MOV) protection or equivalent, rated for application, shall be provided at equipment. Additional protection (gas tubes rated for application) shall be provided within 3.00 feet of building cable entrance or within 3.00 feet of telephone company's network interface.
4. Sensor and Control Wiring Surge Protection: Controllers shall have sensor and control wiring surge protection with optical isolation, MOV, or silicon avalanche devices. Fuses are not permitted for surge protection.

D. Electrical Cabling Materials:
   1. AC Control Wiring:
      a. Control wiring for 24 V circuits shall be insulated copper 18 AWG minimum and shall be rated for 300 VAC service. Low-voltage control wiring and 24 VAC can be run in same conduit.
      b. Control wiring shall be in accordance with National Electrical Code and Local Electrical Codes.
      c. Wiring for 120 VAC shall be 14 AWG minimum and shall be rated for 600 VAC service. Power wiring 120 VAC and greater shall be in a separate conduit. Minimum control wiring conduit size is 0.75 inches EMT.
   2. Analog Input, Analog Output, Binary Input, Binary Output, 24 VAC, and General Purpose Cabling:
      a. Cable shall consist of copper conductors not less than No. 18 AWG stranded.
      b. Cable shall be 2- or 3-conductor twisted cable with a drain wire.
      c. Cable shall have a 100 percent overall shield.
      d. Cable shall be UL Listed and plenum-rated.
      e. Cable shall meet NEC voltage rating of 300 V.
      f. Cable shall be NEC type CMP.
      g. Cable shall meet or exceed UL temperature rating of plus 60 degrees C.
      h. Cable shall be labeled at panel entry with BAS manufacturer's name and type of signal carried within cable, i.e., Analog Input, Analog Output, Binary Input, Binary Output, 24 VAC.
      i. Each cable type specified shall be of a different color coding for easy identification and troubleshooting.
         1) Analog Input Cable.
         2) Analog Output Cable.
         3) Binary Input Cable.
         4) Binary Output Cable.

E. Primary and Secondary Communications Network Cabling:
   1. Cable: Cable shall be of type recommended by BAS manufacturer.
   2. Shielding: 10BaseT cable shall be shielded.
   3. First Tier Network Cable: First tier network cable shall be provided in conduit.
   4. Cable Rating: Cable shall meet or exceed NEC voltage rating of 150 V.
   5. Cable Temperature Rating: Cable shall meet or exceed UL temperature rating of 140 degrees F.
   6. Labeling: Cable shall be labeled at a minimum of every 18.00 inches with BAS manufacturer's name, system name, and communications network name.
   7. Plenum-Rated: Cable shall be plenum-rated.
   8. Color Coding: Each cable type shall be of a different color coding for easy identification and troubleshooting.
   9. Cabling shall be run continuous, splicing is not allowed.

F. Room Sensor Cabling:
   1. Cable: Cable shall consist of copper conductors not less than No. 24 AWG.
   2. Twisted Cable: Twisted cable shall be multi-paired (at least two pairs).
   3. Shielding: Cable shall have a 100 percent overall shield.
   4. Plenum-Rated: Cable shall be UL Listed and plenum-rated.
   5. Cable Rating: Cable shall meet or exceed NEC voltage rating of 300 V.
   6. Cable Type: Cable shall be NEC Type Article 800-CMP.
   7. Cable Temperature Rating: Cable shall meet or exceed UL temperature rating of 165 degrees F.

G. Identification Standards:
   1. Controllers and Local Control Panels: Identify by fastening a plastic engraved nameplate to outside of enclosure.

2. Field Devices: Identify by attaching an engraved or stamped (not handwritten) tag label.
3. Panel Devices: Identify by fastening an engraved or stamped label to backplane of local control panel.

H. Raceway Identification:
Covers to junction and pull boxes of control system raceways shall be painted blue or have identification labels stating “Control System Wiring” affixed to covers. Labels shall be engraved or stamped, not handwritten.

I. Emergency Power:
BAS controllers requiring emergency power shall be connected to emergency power panel circuits. Provide 120 V, single phase, 60-hertz emergency power to every BMS DDC controller panel, HVAC/mechanical equipment controller, PC console power supply, transformer, annunciator, modems, printers, and other devices. Power supplies shall be extended in conduit and wire from emergency circuit breakers.

3.05 PERFORMANCE

A. General:
Unless stated otherwise, control temperatures within plus or minus 2 degrees F humidity within plus or minus 3 percent of setpoint and static pressure within 10 percent of setpoint.

3.06 TEST AND BALANCE REPORT

A. General:
The Controls Contractor shall coordinate with and provide on-site support to the test and balance (TAB) personnel specified under Section 23 05 93 Testing, Adjusting, and Balancing. This support shall include:
1. On-site operation and manipulation of control systems during the testing and balancing.
2. Control setpoint adjustments for balancing all relevant mechanical systems, including VAV boxes.
3. Tuning control loops with setpoints and adjustments determined by TAB personnel.

3.07 COMMISSIONING, TESTING, AND ACCEPTANCE

A. General:
Perform a 3-phase commissioning procedure consisting of field I/O calibration and commissioning, system commissioning, and integrated system program commissioning. Document commissioning information on commissioning data sheets, which shall be submitted prior to acceptance testing. Commissioning work that requires shutdown of system or deviation from normal function shall be performed when operation of system is not required. Commissioning shall be coordinated with Owner and Construction Manager to ensure systems are available when needed. Notify operating personnel in writing of testing schedule so that authorized personnel from Owner and Construction Manager are present throughout commissioning procedure.
1. Prior to System Commissioning: Verify that each control panel has been provided according to plans, Specifications, and reviewed Shop Drawings. Test, calibrate, and bring online each control sensor and device. Commissioning shall include, but not be limited to:
   a. Sensor accuracy at 10, 50, and 90 percent of range.
   b. Sensor range.
   c. Verify analog limit and binary alarm reporting.
   d. Point value reporting.
   e. Binary alarm and switch settings.
   f. Actuator ranges.
   g. Fail-safe operation on loss of control signal, electric power, and network communications.

B. Operational System Demonstration:
After control devices have been commissioned (i.e., calibrated, tested, and signed off), each BAS program shall be put on line and commissioned. Contractor shall, in presence of Owner and Construction Manager, demonstrate each programmed sequence of operation and

compare results in writing. In addition, each control loop shall be tested to verify response and stable control, within specified accuracies. System program test results shall be recorded on commissioning data sheets and submitted for record. Discrepancies between Specification and actual performance shall be immediately rectified and retested.

C. System Performance Verification:
After BAS programs have been commissioned, Contractor shall verify overall system performance as specified. Provide detailed report of tests performed and results, including initial failures and corrective action taken. Tests shall include, but not be limited to:
1. Data Communication: Both normal and failure modes, confirm and demonstrate.
2. Fully Loaded System Response Time: Verify; provide written report.
3. Impact of Component Failures: On system performance and system operation, provide written report.
4. Time/Date Changes: Confirm and demonstrate.
5. End of Month/End of Year Operation: Confirm and demonstrate.
6. Season Changeover: Confirm and demonstrate.
7. Global Application Programs and Point Sharing: Confirm and demonstrate.
8. System Backup and Reloading: Confirm and demonstrate.
9. System Status Displays: Confirm and provide printout.
10. Diagnostic Functions: Confirm and provide printout.
11. Power Failure Routines: Confirm normal to emergency and back to normal; demonstrate.
12. Battery Backup: Confirm continuation, complete operation, and return to normal power; demonstrate.
13. Testing of Electrical and HVAC Systems with Other Divisions of Work: Confirm and provide written report.

D. Acceptance Test Procedure:
Submit for review a detailed acceptance test procedure designed to demonstrate compliance with contractual requirements. This acceptance test procedure shall take place after commissioning procedures but before final acceptance, to verify that sensors and control devices maintain specified accuracies and system performance does not degrade over time. This contractor to include labor to support the formal commissioning team.

E. Performance Period:
After above tests are complete and system is demonstrated to be functioning as specified, a 30-day performance test period shall begin. If system performs as specified throughout test period, requiring only routine maintenance, system shall be accepted. If system fails during test and cannot be fully corrected within eight hours, Owner may request that performance tests be repeated.

3.08 TRAINING

A. Instructor:
Manufacturer shall provide factory-trained instructor to give full instruction to designated personnel in operation of system provided. Instructors shall be thoroughly familiar with subject matter they are to teach. Manufacturer shall provide each student with a student binder containing product-specific training modules for system provided. Training shall be held during normal working hours of 8:00 a.m. to 4:30 p.m. weekdays.

B. Duration:
Provide 8 hrs of training for Owner’s designated operating personnel. Training shall include:
1. General: Explanation of Drawings, O & M Manuals.
2. Walk-Through: Walk-through of job to locate control components, operator workstation, and peripherals.
3. Control: DDC controller and ASC operation/function.
4. Operator Control Functions: Including graphic generation and field panel programming.
5. Portable Terminal: Operation of portable operator’s terminal.
6. Control Technical Support: Explanation of adjustment, calibration, and replacement procedures.

7. Training Material: Student binder with training modules:
    a. System log-on procedures.
    b. Review of sequence of operations.
    c. System troubleshooting.
    d. Emergency service interface.
    e. Fire alarm interface.
    f. System restart after power failure.
    g. System backup and restoration procedures.
    h. Replacement procedures of each system component.
    i. Calibration and initialization procedures.
8. Startup Procedures: Regeneration procedures on provided programming at operator's control stations.
9. Maintenance Programs: Operation of maintenance services programs.

3.09 POINT SCHEDULE MATRIX – I/O SCHEDULE

A. General:
Following points, as defined for each piece of equipment, are designated as follows:
1. Digital Out (DO): Defined as two-state output (i.e., start/stop, enable/disable).
2. Digital In (DI): Defined as two-state input (i.e., alarm, status).
3. Analog In (AI): Defined as variable input (i.e., temperature, position).
4. Analog Out (AO): Defined as electrical variable output. 0 to 20 mA, 4 to 20 mA, and 0 to 10 VDC are only acceptable analog outputs. Driver for analog outputs shall come from both hardware and software resident in controllers. Transducers shall not be acceptable.
5. Points List: See I/O points list on Drawings.

END OF SECTION 23 09 00

SECTION 23 64 33
VERTICAL STORAGE TANK

PART 1 GENERAL

1.01 FURNISHED BY CONTRACTOR INSTALLED BY CONTRACTOR (FCIC)

A. Vertical Storage Tank(s) shall be Furnished by Contractor, Installed by Contractor (FCIC)

1.02 SYSTEM DESCRIPTION

A. Equipment item is listed below by Equipment I.D. Tag.
   1. Vertical Storage Tank and Installation.
      a. Used Oil 1,000 gal. Storage Tank - Equipment I.D. Tag: MB-01 (Qty. 1)
      b. Brine Water 10,000 gal. Storage Tank - Equipment I.D. Tag: BR-03 (Qty. 1)
   2. Vertical Storage Tank system(s)
   3. This section includes the specifications for the Vertical Storage Tank(s) being installed for storage of fluids as noted in the Bid Specifications and Bid Drawing Package.
      a. Vertical Storage Tank – Description of System(s)
         1) The configurations for tire storage are described below.
            (a) Vertical Storage Tank system: Shall be a “stand alone” system.

B. Seismic Calculations
   1. For seismic calculations, Reference general seismic design criteria noted on Sheet S0.1 Division 1 – General, A.9.

C. List of Applicable Forms
   1. The General Conditions, Supplementary Conditions, Instructions to Bidders, Bid Form, all apply to these bid items.

1.03 DESCRIPTION OF WORK

A. List of Work
   1. The extent of the Work is shown on the drawings and is defined to include (but not by way of limitations) all labor, materials, freight, unloading, equipment, taxes, permits and supervision required for the fabrication and installation of the Vertical Storage Tank(s). The Vertical Storage Tank system shall include all materials necessary for the desired performance. Wall ties, column ties, or any other method of affixing storage system to the building walls or structure is not permitted.

B. Coordination
   1. Contractor’s Responsibility: It will be the Contractor's responsibility to verify and establish a detailed installation schedule.
   2. Field Check: ALL BUILDING AND EQUIPMENT LAYOUT DIMENSIONS SHALL BE FIELD CHECKED AND VERIFIED BY CONTRACTOR PRIOR TO START OF INSTALLATION. NOTIFY THE CONSULTANT AND OWNER OF ANY DISCREPANCIES OR CONDITIONS AFFECTING MATERIALS AND/OR INSTALLATION WITHIN TEN (10) DAYS. IF A CONDITION EXISTS AND THE CONSULTANT OR OWNER IS NOT NOTIFIED THE ADDITIONAL COST TO CORRECT THE INSTALLATION IN ACCORDANCE WITH THE REQUIREMENTS OF THE OWNER WILL BE THAT OF THE CONTRACTOR.
   3. Delivery and Unloading: The Vertical Storage Tank Contractor shall be responsible for coordinating the delivery and unloading of the equipment to the job-site with the General Contractor to eliminate demurrage charges, unless authorized by the Owner or the Consultant. In order to eliminate disruption to the ongoing operations and prevent interference of dock access by trucks entering and leaving the site, temporary staging of materials will be provided outside of the building at a location designated by the Owner. The Vertical Storage Tank Contractor shall provide storage facilities (i.e., covers, closed containers) to protect equipment from the elements (i.e., dust, dirt, rain, ice, snow, etc.) as necessary. Interior staging of equipment will be kept to a minimum so as not to disrupt ongoing operations.

1.04 QUALITY ASSURANCE

A. Standards
   1. Equipment Standards: The equipment covered by these Specifications shall be designed, assembled, tested and installed in accordance with the latest applicable standards, including:
      a. American National Standards Institute (ANSI).
      b. American Iron and Steel Institute.
         1) Specification for Design of Cold-Formed Steel Association - "Structural Members" 2015 edition.
   2. International Building Code (IBC)
      a. International Building Code including current Building Code Amendments. (2015 Edition)
   3. Materials
      a. All materials furnished shall be new, free from defects, and UL-Approved where such approval is granted to the equipment to be furnished.
   4. Federal Inspection
      a. Latest published applicable Federal Specifications.
   5. OSHA
      a. Applicable OSHA Specifications.
   6. Building and Safety Codes
      a. Any applicable local building and safety codes pertaining to the Work.

B. Workmanship
   1. Trade Methods: Use the best trade methods throughout. Work evidencing substandard workmanship shall be corrected or replaced by the Contractor at the Contractor's expense, per the General Conditions.
   2. Welding: Areas to be welded shall be free from rust, grease, or other foreign matter for a distance of at least one-half inch (1/2") back from the edge of the weld. Prevent warping in finished product; use jigs, if necessary. Grind welds smooth on exterior exposed surfaces. All Work to standard tolerances, careless template work is not acceptable. All welds to be painted to match factory finish.

C. Touch Up Paint: The method for the touch up of paint shall follow specifications section 3.02 Field Painting.

D. Guarantees
   1. WARRANTY:
      a. Warranty shall be the manufacturer's standard warranty and shall be specified by the Contractor in the contents of the proposal.
      b. The contractor shall provide an extended warranty for a period of three (3) years from Date of Acceptance.
      c. QUALITY OF MATERIALS AND EQUIPMENT: The Contractor guarantees the material and equipment delivered under the Contract to be free from defects in design or workmanship and against damages caused prior to final inspection. Unless otherwise specified, this guarantee extends for a period of three (3) years from the Date of Acceptance for both labor and materials.
      d. REPAIRING DEFECTS: The Contractor shall promptly repair or replace all defective or damaged items delivered under the Contract. The Vertical Storage Tank(s) Contractor may elect to have any replaced item returned to his/her plant at his/her expense.
      e. STRUCTURAL DESIGN: It is the Contractor's responsibility to guarantee a functional and structurally sound Vertical Storage Tank(s) design in accordance with the drawings, specifications, and codes.

1.05 SUBMITTALS

A. Product Data: Submit latest edition of Vertical Storage Tank(s) data sheet and outline drawing with the proposal.

B. Shop Drawings:

1. Shop Drawings, as stated in the General Conditions, shall include, but need not be limited to:
2. Installation Plan: Proposed installation plan of storage tank(s), including location and dimensions of new equipment clearly identified. It will be the Contractor's responsibility to verify and establish a detailed installation schedule per the General Conditions.
3. Storage tank(s) are to be a standalone system.
4. Dimensions: Elevation views showing all component dimensions and all product and aisle clearance dimensions.
5. Bill of Materials: Bill of Materials per the General Conditions.
6. Calculations: Shop drawings, load, and seismic calculations shall be submitted within twenty-one (21) days after receipt of order.
7. Approved Shop Drawings
8. It will be the Contractor's responsibility to obtain approved shop drawings signed by the Consultant and/or Owner per the General Conditions prior to fabrication.

C. Manufacturer’s Reference:
1. Prime Manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

Snyder Industries, LLC

6940 O Street, Suite 100

Lincoln, Nebraska 68510 USA

Phone: (402) 467-5221

Website: https://www.syndernet.com/

Vehicle Service Shop – Waste Oil Storage Tank Model: 1,000 gal. 5990102N

Brine Station - Brine Water Storage Tank Model: 10,000 gal. 1006600N43

Household Hazard Waste Collection Facility –

Waste Oil Storage Tank Model: 405 gal. 5990702N

Waste Antifreeze Storage Tank: 360 gal. 5760102N

2. Other manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers may be considered as equal.

PART 2 PRODUCTS

2.01 INDUSTRIAL STORAGE TANK(S) STORAGE TANK(S) STORAGE SYSTEM GENERAL

A. The Contractor shall provide the following:
1. List of Required Items
a. New Vertical Storage Tank as shown on the drawings, including freight, unloading, installation, touch-up painting, cleaning, and other equipment necessary to complete the system.
b. Systems to include all fittings, hardware, screens and restraints.

B. Quantity and Capacity
1. See drawings for equipment location and configuration.

C. Standard Designs
1. Components shall be of standard design and fabrication by the manufacturer so that all may be replaced or purchased at a future date without special charges or extended deliveries.

D. The Bill of Materials for this Work is to be determined by the Contractor from the bid drawings and contents of the specifications. Storage tank(s) system Contractor to verify all information.

E. Codes
1. The Vertical Storage Tank shall be designed and installed to the exact standards of the manufacturer and in all cases shall conform to applicable codes. The Vertical Storage

Tank contractor will submit manufacturer's certified design calculations for the storage tank(s) system to the Owner or Consultant for review.

F. Loads and Capacity
   1. The Storage tank(s) System shall be designed to handle the Load/Capacity specified in the design criteria.
   2. The Freestanding Storage tank(s) System components shall utilize materials of a sufficient capacity to accept the stated load conditions without infringing upon the published Load Safety Factor of the load bearing members.

G. Finish
   1. Finish will be Manufactured Standard.

H. Erection
   1. All shipments of the Freestanding Storage tank(s), system shall include all components to allow immediate erection upon receipt.

I. Anchoring
   1. All work must be rigid and anchored securely. Method of attachment to be approved prior to installation.
   2. Anchor Holes
   3. All anchor holes are to be vacuum cleaned at time of drilling to prevent dust build up.

J. Touch Up
   1. The Freestanding Storage tank(s) Storage System Contractor shall touch up any other Contractor's work damaged during the process per section 3.02 Field Painting.

2.02 VERTICAL FREESTANDING STORAGE TANK(S) W/LEVEL GAUGE

A. Equipment Tag # MB-10 (Qty. 1) Vehicle Service Shop
   1. General: 1,000 gal. Used Oil Storage Tank.
      a. Description: Stationary, storage tank(s) unit in the Vehicle Maintenance, Repair Bay used for storage of Used Oil.
         1) Physical Data:
            (a) Overall Dimensions:

(1)	Diameter:	78”
(2)	Height:	69”
(3)	Number of Outlets:	1
(4)	Number of Manway:	1
(5)	Lids:	1/integrated with Manway
(6)	Capacity:	1,000 gal.
(7)	Containment %:	120% containment around primary tank.

   2. Features and Construction:
      a. Double Wall Construction
      b. Complies with EPA CFR 40-279.22
      c. 2-year Manufacturer's warranty
      d. Finish: Manufacture Standard

B. Equipment Tag # BR-03 (Qty. 1) Brine Station
   1. General: 10,000 gal. Brine Water Storage Tank.
      a. Description: Stationary, storage tank unit onsite used for storage of brine water.
      b. Physical Data:
         1) Overall Dimensions:

(a)	Diameter:	142”
(b)	Height:	227.3”
(c)	Number of Outlets:	1
(d)	Number of Manway:	1
(e)	Lids:	18” PE Threaded/Vented Manway
(f)	Max. Access:	15”
(g)	Capacity:	10,000 gal.
(h)	Containment %:	120% containment around primary tank.

2. Features and Construction:
   a. Double Wall Construction
   b. Complies with EPA CFR 40-279.22
   c. 2-year Manufacturer's warranty
3. Finish: Manufacture Standard

C. Equipment Tag # WO-01 (Qty. 1) Household Hazard Waste Collection Facility
1. General: 405 gal. Waste Oil Storage Tank.
   a. Description: Stationary, storage tank unit onsite used for storage of waste oil.
   b. Physical Data:
      1) Overall Dimensions:

(a)	Diameter:	45"
(b)	Height:	73.1"
(c)	Number of Outlets:	1
(d)	Number of Manway:	1
(e)	Lids:	18" PE Threaded/Vented Manway
(f)	Max. Access:	15"
(g)	Capacity:	405 gal.
(h)	Containment %:	120% containment around primary tank.

2. Features and Construction:
   a. Double Wall Construction
   b. Complies with EPA CFR 40-279.22
   c. 2-year Manufacturer's warranty
3. Finish: Manufacture Standard

D. Equipment Tag # WA-01 (Qty. 1) Household Hazard Waste Collection Facility
1. General: 360 gal. Waste Antifreeze Storage Tank.
   a. Description: Stationary, storage tank unit onsite used for storage of waste antifreeze.
   b. Physical Data:
      1) Overall Dimensions:

(a)	Diameter:	49"
(b)	Height:	67.2"
(c)	Number of Outlets:	1
(d)	Number of Manway:	1
(e)	Lids:	18" PE Threaded/Vented Manway
(f)	Max. Access:	15"
(g)	Capacity:	360 gal.
(h)	Containment %:	120% containment around primary tank.

2. Features and Construction:
   a. Double Wall Construction
   b. Complies with EPA CFR 40-279.22
   c. 2-year Manufacturer's warranty
3. Finish: Manufacture Standard

PART 3 EXECUTION

3.01 EXAMINATION

A. Coordination
1. Each Contractor must give careful consideration to the ongoing facility operations and the work of other contractors during the entire project and shall organize his/her work so that it will not interfere with ongoing operations or interfere with or delay the work of others. Minimal disruption to ongoing operations is a priority. It is imperative that the schedule be maintained with any changes coordinated promptly with the General Contractor, Owner, and Consultant.

B. General Description

1. The Storage tank System shall be installed true and properly aligned complete in all details and in accordance with the specifications, manufacturer's recommendations, and the drawings.

C. Installation Routine
1. Installation shall include unloading, checking and security of equipment prior to erection, complete anchoring, touch up and cleaning. The Contractor shall provide storage facilities (i.e., covers, closed containers) to protect equipment from the elements (i.e., dust, dirt, rain, snow, etc.). Contractor to ensure no damage to the floor, facility or equipment.

D. Tools and Equipment
1. The Contractor shall be responsible to provide all tools and equipment necessary for a complete and satisfactory installation. All wheeled and rolling equipment used in the building during construction (after slab on grade has been poured) must use wheel wraps as drip diapers or similar to protect floor from rubber marking and equipment spillage of oil or other substances.

E. Construction, lifts, man Lifts and Vehicles
1. All wheeled and rolling equipment used in the building during construction (after slab on grade has been poured) must use wheel wraps as drip diapers or similar to protect floor from rubber marking and equipment spillage of oil or other substances.

F. Permits and Inspection
1. Contractor shall obtain, and pay for, all necessary permit fees and inspections required by the State or local municipalities.

G. Damaged Materials
1. Claims, due to freight damage, are the responsibility of Vertical Storage Tank Contractor. This includes any damage that is not evident at the time of the unloading of the equipment (i.e., concealed damage). Should such damage be uncovered, the Contractor must act promptly to repair/replace damaged equipment to minimize any delay to the schedule. Any added cost due to a delay is the responsibility of the Contractor.

H. Debris Disposal
1. It shall be the responsibility of the Vertical Storage Tank Contractor to remove any debris resulting from his/her work on each and every workday to a pre-designated disposal area. This shall include all waste generated by the installer or any of his/her personnel, shipping containers, and/or construction materials. The Contractor shall broom clean the area each work day to leave the work area clean. This will include organizing the materials not yet incorporated in the Work. At the completion of the work the Contractor shall remove all of his/her waste materials and rubbish from and about the project, as well as all his/her tools, construction equipment, machinery and surplus materials.

I. Clearance
1. The Contractor shall be responsible for maintaining all clearances specified on the drawings.

J. Modifications
1. The Contractor shall be responsible for the suitability of any Vertical Storage Tank component modifications required after installation begins. All modifications must be submitted and approved by the Owner and Consultant prior to beginning Work. Modifications done by others must be approved by the Contractor prior to modification. The Contractor shall be responsible for such a modification by others.

K. Contractor’s Survey of Damage
1. The Contractor shall conduct a survey of his/her work each and every workday morning and note any and all damages observed. Any damages must be reported to the General Contractor and the Owner by 9:00 a.m. Damages not reported within this time frame will be the contractor’s responsibility.

L. Marking Restrictions
1. Under no circumstances will a magic marker, sharpie or any other permanent marking device, which will absorb into concrete, paint or decking, be used for marking equipment

locations. All markings must be water soluble and removable. The contractor is responsible to remove these markings prior to completing the Punch List

M. Installation
   1. The Owner shall have the option of performing his/her own Storage Tank System installation.

3.02 FIELD PAINTING

A. Cleaning
   1. All surfaces to be thoroughly cleaned of rust, scale, oil, grease, dirt, welding flash and all other forms of dirt detrimental to clean finish.

B. Touch-Ups
   1. After the erection and installation are complete, the Contractor shall touch-up any scratches on the Storage tank(s) Storage system. Finish to match factory finish.

END OF SECTION 23 13 23. 16

This page intentionally left blank

SECTION 23 21 13
HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe and fitting materials and joining methods for the following:
   1. Copper tube and fittings.
   2. Steel pipe and fittings.
   3. Joining materials.
   4. Transition fittings.
   5. Dielectric fittings.

1.02 RELATED REQUIREMENTS

A. Section 23 21 23 "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

B. Section 23 07 19 “HVAC Piping Insulation” for piping insulation.

1.03 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.04 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

1.05 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of the following:
   1. Piping, tubing and fittings data. Submit data indicating that pipe, tube and fittings are manufactured exclusively in the United States.
   2. Fittings.
   3. Joining materials.
   4. Coating data. Include product information and coating procedures.

C. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

C. Welding (WPS) and Brazing (BPS) Procedure Specifications.

D. Field quality-control reports.

1.07 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
   1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.08 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations or coring of foundation wall penetrations.

C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations.

D. Coordinate pipe fitting pressure classes with products specified in related Sections.

E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base.

F. Coordinate installation of pipe sleeves or coring of existing walls for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 07 Section "Penetration Firestopping" for fire and smoke wall and floor assemblies.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
   1. Hot-Water Heating Piping: 150 psig at 200 deg F.
   2. Condenser-Water Piping: 100 psig at 150 deg F.

2.02 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L, ASTM B 88 Type K.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. Copper or Bronze Pressure-Seal Fittings:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Viega, LLC.
      b. NIBCO, INC.
   2. Housing: Copper.
   3. O-Rings and Pipe Stops: EPDM.
   4. Tools: Manufacturer's special tools.
   5. Minimum 200-psig working-pressure rating at 250 deg F

D. Wrought-Copper Fittings: ASME B16.22.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Anvil International, Inc.
      b. S. P. Fittings; a division of Star Pipe Products.

2.03 STEEL PIPE AND FITTINGS

A. Piping and fittings shall be manufactured exclusively in the United States.

B. Steel Pipe, NPS □ through NPS 1□: ASTM A53, Type S (seamless) Grade A, Schedule 40, black steel, plain ends.

C. Steel Pipe, NPS 2 through NPS 10: ASTM A53, Type S (seamless) and Type ERW (welded) Grade A or B, Schedule 40, black steel, plain ends.

D. Steel Pipe, NPS 12 and larger: ASTM A53, Type S and Type ERW (welded) Grade B, 0.375 inch wall thickness, black steel, plain ends.

E. Steel Pipe Nipples: ASTM A733 made of ASTM A53, Schedule 40, black steel; seamless.

F. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.

G. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.

H. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   1. Material Group: 1.1.
   2. End Connections: Butt welding.
   3. Facings: Raised face.

I. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

J. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

K. Grooved Mechanical-Joint Fittings and Couplings:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Victaulic Company
      b. Anvil International
   2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
   3. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

2.04 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel if unexposed, 316 stainless steel if flange is exposed.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping
   1. CPVC Piping: ASTM F 493.
      a. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.05 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. NIBCO INC
b. IPEX USA
c. Charlotte Pipe and Foundry
d. Wilkins; a Zurn company
2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. NIBCO INC
b. IPEX USA
c. Charlotte Pipe and Foundry
2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.06 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Capitol Manufacturing Company.
b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
c. Wilkins; a Zurn company.
2. Description:
a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig minimum at 180 deg F
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Capitol Manufacturing Company.
b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
c. Wilkins; a Zurn company.
2. Description:
a. Standard: ASSE 1079.
b. Factory-fabricated, bolted, companion-flange assembly.
c. Pressure Rating: 175 psig.
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company
      d. Pipeline Seal and Insulator, Inc.
   2. Description:
      a. Nonconducting materials for field assembly of companion flanges.
      b. Pressure Rating: 150 psig
      c. Gasket: Neoprene or phenolic.
      d. Bolt Sleeves: Phenolic or polyethylene.
      e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elster Perfection
      b. Grinnell Mechanical Products
      c. Matco-Norca, Inc.
      d. Precision Plumbing Products, Inc.
      e. Victaulic Company
   2. Description:
      a. Standard: IAPMO PS 66.
      b. Electroplated steel nipple, complying with ASTM F 1545.
      c. Pressure Rating: 300 psig at 225 deg F.
      d. End Connections: Male threaded or grooved.
      e. Lining: Inert and noncorrosive, propylene.

PART 3 EXECUTION

3.01 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2-1/2 and smaller, shall be the following:
   1. Type L drawn-temper copper tubing, with 95-5 soldered wrought-copper fittings.
   2. Insulated per Section 23 07 19 HVAC Piping Insulation.

B. Hot-water heating piping, aboveground concealed areas, NPS 3 and larger, shall be the following:
   1. Black steel pipe, ASTM A53, Type S (seamless) or Type ERW (welded); with standard weight ASTM A234 forged steel fittings for butt-weld connection and flanged joints.
   2. Insulated per Section 23 07 19 HVAC Piping Insulation.

C. Hot-water heating water piping, aboveground exposed areas and mechanical rooms, NPS 2-1/2 and larger, shall be any the following:
   1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
   2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
   3. Insulated per Section 23 07 19 HVAC Piping Insulation.

D. Condenser-water piping, aboveground concealed areas, NPS 2 and smaller, shall be the following:
   1. Type L drawn-temper copper tubing, with 95-5 soldered wrought-copper fittings.
   2. Insulated per Section 23 07 19 HVAC Piping Insulation.

E. Condenser-water piping, aboveground concealed areas, NPS 2-1/2 and larger, shall be the following:
   1. Black steel pipe, ASTM A53, Type S (seamless) or Type ERW (welded); with standard weight ASTM A234 forged steel fittings for butt-weld connection and flanged joints.

2. Insulated per Section 23 07 19 HVAC Piping Insulation.

F. Condensate-Drain Piping: Type L drawn-temper copper tubing, with 95-5 soldered wrought-copper fittings

3.02 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings or integrally reinforced forged branch outlet fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to the following:
   1. Section 23 05 23.12 "Ball Valves for HVAC Piping."
   2. Section 23 05 23.14 "Check Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

U. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for identifying piping.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 18 "Escutcheons for HVAC Piping."

3.03 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 and Larger: Use dielectric flange kits.

3.04 HANGERS AND SUPPORTS

A. Comply with requirements in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Comply with requirements in Section 23 05 48 "Vibration and Seismic Controls for HVAC" for seismic restraints.

C. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long
   2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
   4. Spring hangers to support vertical runs.
   5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
   6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4: Maximum span, 7 feet.
   2. NPS 1: Maximum span, 7 feet.
   3. NPS 1-1/2: Maximum span, 9 feet.
   4. NPS 2: Maximum span, 10 feet.
   5. NPS 2-1/2: Maximum span, 11 feet.
   6. NPS 3 and Larger: Maximum span, 12 feet.

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
   2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
   3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
   4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
   7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

3.05 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

I. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

J. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.06 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 23 05 19 "Meters and Gages for HVAC Piping."

3.07 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Inspect finish of exposed, hydronic piping, including outlets, valves, specialties, and devices, after installation is complete. Remove burrs, dirt, and debris. Repair damaged finishes including chips, scratches, and abrasions.
3. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
4. Flush hydronic piping systems with minimum 5 ft/s velocity clean water; then remove and clean or replace strainer screens. Promptly passivate and chemically treat piping systems after flush per requirements in Section 23 25 13 “Water Treatment for Closed-Loop Hydronic Systems.”
5. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
6. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:
1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

3.08 CLEANING AND PROTECTION

A. Remove all packaging, unused fasteners, and other installation materials from the project site.

B. Provide protection as required to leave the work in undamaged condition at the time of completion.

3.09 PAINTING

A. Refer to Section 09 90 00 "Painting and Coating" for additional requirements.

B. Coating system consists of surface prep, base coat of Carbomastic 15 and a top coats of Carbothane 134, or equivalent.
1. Install:
a. Surface Prep - SSPC SP1-3
b. 1st coat – 7.0 to 10.0 mils Carbomastic 15 Aluminum Flake Epoxy Mastic
c. 2nd and 3rd coats - Carbothane 133 satin or 134 Gloss Aliphatic Urethane
2. Manufactured by Carboline.
3. Color shall be white.
4. All manufacturer’s installation instructions, including surface preparation, application methods and equipment, mixing and thinning guidelines, application conditions, and curing schedule shall be adhered to.

END OF SECTION 23 21 13

This page intentionally left blank

SECTION 23 21 13.13

UNDERGROUND HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Underground pre-insulated PEX pipes and fittings.

1.02 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For the following:
   1. All piping data. Submit data indicating that pipe, tube and fittings are manufactured exclusively in North America, Germany or Italy.

C. Shop Drawings: For underground hydronic piping. Signed and sealed by a professional engineer.
   1. Calculate requirements for expansion compensation for underground piping.
   2. Show expansion compensators, offsets, and loops with appropriate materials to allow piping movement in the required locations. Show anchors and guides that restrain piping movement with calculated loads.
   3. Show pipe sizes, locations, and elevations. Show piping in trench, conduit, and cased pipe with details showing clearances between piping, and show insulation thickness.
   4. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the pipe vault structure.
   5. Show locations of pipe anchors and alignment guides and expansion joints and loops.
   6. Show wiring diagram for leak detection system. Clearly mark panel locations and linear footages associated with leak detection monitoring.

1.04 INFORMATIONAL SUBMITTALS

A. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and at vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing hydronic piping.

B. Qualification Data: For qualified Installer.

C. Welding certificates.

D. Material Test Reports: For piping.

E. Source quality-control reports.

F. Field quality-control reports.

G. Butt fusion welding joint reports.

H. HDPE fusion welded joint kit reports.

I. PEX joint reports.

1.05 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
   1. Comply with provisions in ASME B31.9, "Building Services Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 PRODUCTS

2.01 PREINSULATED CROSSLINKED POLYETHYLENE (PEX) PIPE AND FITTINGS

A. Manufacturers:
   1. Uponor- Ecoflex Pre-insulated PEX
   2. REHAU Construction LLC-Insulpex with RAUPEX ASTM-sized Carrier Pipe

B. Service Tubing:
   1. Material: Crosslinked polyethylene (PEX) manufactured to PEX-a or Engel-method standard
   2. Material Standard: Manufactured in accordance with ASTM F876 and F877
   3. Pressure Ratings: Hydrostatic design and pressure ratings are in accordance with the ASTM standard. Operating limits are as follows.
   4. -58 degrees F to 203 degrees F at 80 psi
   5. The PEX service tubing in the Ecoflex Thermal Single pipe has an oxygen diffusion barrier that does not exceed an oxygen diffusion rate of 0.10 grams per cubic meter per day at 104 degrees F water temperature in accordance with German DIN 4726.
   6. Nominal Inside Diameter: Provide tubing with nominal inside diameter in accordance with ASTM F876, as indicated.
      a. 1 inch
      b. 1.25 inch
      c. 1.5inch

C. Outer Jacket:
   1. Material is corrugated seamless high-density polyethylene (HDPE).
   2. The HDPE jacket completely encompasses and protects the insulation from moisture and damage.
   3. The outer jacket is extruded directly over the insulation and is flexible.
   4. The outer jacket shall contain 2 percent carbon black, finely divided and thoroughly dispersed to provide protection from UV degradation.
   5. Minimum Bend Radius
      a. 1-inch pre-insulated tubing with 5.5-inch jacket has a bend radius of 10 inches.
      b. 1□-inch pre-insulated tubing with 5.5-inch jacket has a bend radius of 12 inches.
      c. 1□-inch pre-insulated tubing with 6.9-inch jacket has a bend radius of 16 inches.

D. Insulation:
   1. The insulation shall be layered, expanded cross-linked water-resistant polyethylene closed-cell foam.
   2. All seams of the insulation shall be sealed.
   3. Insulation shall not be bonded to the service tubing.

E. Straight Run Joints: Shall be insulated to the same thickness as the pipe and jacketed with an electro-fusion welded split sleeve.
   1. The manufacturer shall provide the fusion machine, straps, bands, pressure gauges and closure patches for the pressure testable joint cover.
   2. Heat shrink materials will not be accepted for field joints or the repair of the field joints that do not pass the pressure tests

3. All field joints shall be pressure tested to ensure air tightness at 5 psi for 5 minutes while being soap tested for leaks.

F. Compression Fittings for PEX Service Tubing
   1. For system compatibility, use fittings offered by the tubing manufacturer.
   2. Fittings are to be manufactured from dezincification-resistant brass.
   3. The fitting assembly must comply with performance requirements of ASTM F877.
   4. The fittings will consist of a compression fitting with a coupling sleeve, a fitting body insert with O-ring(s) and a bolt and nut.
   5. All buried fittings will be installed, insulated, and sealed in accordance with the piping manufacturer's instructions.
   6. Male NPT thread for each compression fitting is shown below.
      a. 1-inch PEX compression fitting has 1-inch male NPT thread.
      b. 1.25-inch PEX compression fitting has 1.25-inch male NPT thread.
      c. 1.5-inch PEX compression fitting has 1.5-inch male NPT thread.
   7. All transition fittings connecting to the compression fittings shall be manufactured of dezincification-resistant brass.

G. ACCESSORIES
   1. Use accessories associated with the installation of the pre-insulated PEX-a distribution piping system as recommended by or available from the manufacturer.
   2. Insulation Kits
      a. Insulation kits will be manufactured of ABS shells or HDPE sleeves, will feature equal thickness of closed-cell PEX insulation as the pipe, and sealed watertight.
   3. Connection Vaults
      a. The piping manufacturer will provide the connection vaults when required by the project construction.
      b. Connection vaults shall be constructed of rotationally molded composite polyethylene and PE foam, providing a structurally sound and thermally insulated chamber.
      c. Heat shrink seals as provided by the tubing manufacturer shall be installed to prevent introduction of water into the vault.
   4. Anchors: As detailed on the Drawings.

2.02 LEAK DETECTION

A. The system shall include two wires between the carrier pipe and the HDPE jacket. The piping system manufacturer shall install the wire in a manner that has the wire is incorporated into each piece of pre-insulated pipe and fittings. This wire is to be capable of detection through the entire run including field joints and fittings.

B. The system shall be capable of alarming based upon impedance or resistance and shall consist of two wires for detection.

C. A detector (or multiple detectors if necessary) shall be provided and installed (including routing power to the unit and integration of alarms to the campus EMS system). The detector shall include an integral TDR impulse reflectometer.

D. A web-based interface shall be provided along with any necessary data connections. This shall be provided in addition to the integration with the EMS system called for in paragraph 3.
   1. The web-based interface shall be accessible from any location with internet access.
   2. If the service is fee based a 10-year subscription shall be provided by the contractor.
   3. The system shall be capable of alerting facilities personnel via email or text if an event were to occur.

E. The installed system shall be capable of monitoring the entire piping distribution system being provided as part of this project.

F. During the commissioning of the system a location map shall be provided with the system indicating the "As Installed" system configuration and sensing string layout. Footage along the cable shall be provided as references to locate leaks.

PART 3 EXECUTION

3.01 EARTHWORK

A. See Section 31 20 00 "Earthwork" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATION

A. Hot-Water Heating Piping:
   1. NPS 3 and smaller: Underground pre-insulated factory pre-insulated PEX piping system with 1.3-inch insulation and corrugated LDPE casing.

3.03 SPARE PARTS

A. As it is anticipated that rerouting will be required on the project the procurement of piping above and beyond the quantities required to perform the project according to the Drawings is required. The following quantities of spare parts for heating hot water piping shall be provided (all piping shall be XX” in diameter to match the system being installed):
   1. (XX) 10-feet straight pieces of piping.
   2. (XX) 45-degree fittings.
   3. (XX) 90-degree fittings.
   4. (XX) Joint closure kits.

3.04 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Remove standing water in the bottom of trench.

C. Do not backfill piping trench until field quality-control testing has been completed and results approved.

D. Install piping at uniform grade of 0.2 percent. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points and elsewhere as required for system drainage. Install manual air vents at high points.

E. In conduits, install drain valves at low points and manual air vents at high points.

F. Install components with pressure rating equal to or greater than system operating pressure.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. See Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping" for sleeves and mechanical sleeve seals through exterior building walls.

J. Secure anchors with concrete thrust blocks. Concrete is specified in Section 03 30 00 "Cast-in-Place Concrete."

3.05 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs for HDPE and steel pipe. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

F. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

G. Conduit and Cased Piping Joints: Assemble sections and finish joints with pourable insulation and exterior jacket sleeve and apply fusion welded seals (shrink-wrap seals are allowable where dictated in Chapter 2).

H. Butt Fusion: The pipe shall be joined by the butt fusion process outlined in ASTM F2620 or PPI TR-33. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations. Fusion joints shall be made per qualified technicians per PPI TN-42.

I. Butt Fusion joint recording: The critical parameters of each fusion joint shall be recorded by an electronic data logging device. All fusion joint data shall be included in a Fusion Technician's joint report.

3.06 IDENTIFICATION

A. Install continuous plastic underground warning tapes during back filling of trenches for underground hydronic piping. Locate tapes 6 to 8 inches below finished grade, directly over piping. See Section 31 20 00 "Earth Moving" for warning-tape materials and devices and their installation.

3.07 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Prepare hydronic piping for testing according to ASME B31.9 and as follows:
      a. Leave joints, including welds, uninsulated and exposed for examination during test.
      b. Fill system with water. Where there is risk of freezing, air or a safe, compatible liquid may be used.
      c. Use vents installed at high points to release trapped air while filling system.
   2. Test hydronic piping as follows:
      a. Subject hydronic piping to hydrostatic test pressure that is not less than 100 PSI for chilled water and 150 PSI for heating hot water.
      b. After hydrostatic test pressure has been applied for 10 minutes, examine joints for leakage. Remake leaking joints using new materials and repeat hydrostatic test until no leaks exist.
   3. Test conduit as follows:
      a. Seal vents and drains and subject conduit to 15 psig for four hours with no loss of pressure. Repair leaks and retest as required.

C. Prepare test and inspection reports.

END OF SECTION 23 21 13.13

This page intentionally left blank

SECTION 23 21 16
HYDRONIC PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hydronic specialty valves.

B. Air-control devices.

C. Strainers.

D. Connectors.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product:
   1. Include construction details and material descriptions for hydronic piping specialties.
   2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
   3. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.06 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 PRODUCTS

2.01 HYDRONIC SPECIALTY VALVES

A. Bronze, Calibrated-Orifice, Balancing Valves:
   1. Manufacturers:
      a. Bell & Gossett, A Zylem brand.
      b. Arstrong Pumps, Inc.
      c. TACO Comfort Solutions, Inc.
   2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
   3. Ball: Brass or stainless steel.

4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

B. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
1. Manufacturers:
   a. Bell & Gossett, A Zylem brand.
   b. Arstrong Pumps, Inc.
   c. TACO Comfort Solutions, Inc.
2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

C. Pressure-Independent Flow Control Valves:
1. Manufacturers:
   a. Flow Control Industries DeltaPValve.
   b. Belimo ePIV.
2. All modulating control valves shall be industrial quality and must be fully field-rebuildable. Valves shall be designed to last 100,000+ on/off cycles.
3. Each control valve shall be individually factory flow tested and calibrated to deviate by no more than 5% through the entire operating differential pressure range without the use of additional electronics. All valves shall be tested on a test stand calibrated and verified with traceability to NIST standards.
4. The control valve operating differential pressure range shall be 5 to 70 or 10-90 PSID and shall be equal to or greater than the associated pump's design head pressure.
5. Each control valve shall have a calibrated performance tag listing the measured flow rate in rotation increments of 10 degrees through full stroke. Multi-turn actuators are not acceptable.
6. Control valves shall be factory set not-to-exceed the coil design flow rate.
7. Balancing labor, balancing valves and flow limiting devices are not required.
8. Valve bodies 2" and smaller shall be brass. Valve bodies 3" and larger shall be ductile iron. Internal control surfaces and pressure regulator components shall be brass, stainless steel, carbon steel, EPDM or Teflon.
9. All control valves shall have three (3) factory-installed Pressure/Temperature ports to allow factory and field verification of flow and proper operation. These ports shall be located at the inlet, intermediate, and outlet locations of the valve. The intermediate port must be located between the control surface and pressure regulator.
10. Control valve flow characteristics shall be field-modifiable, and may be modified inline.
11. Control valves shall be warranted by the manufacturer for a full 10 years from the date of purchase.

D. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.
1. Manufacturers:
   a. Conbraco Industries, Inc.
   b. Watts Industries, Inc.; Watts Regulators.

c. Zurn-Wilkins.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: stainless steel removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

E. Diaphragm-Operated Safety Valves: ASME labeled.
1. Manufacturers:
a. Conbraco Industries, Inc.
b. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.
c. Kunkle Valve Division.
d. Spence Engineering Company, Inc.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.02 COIL PIPING PACKAGE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. NuTech Hydronic Specialty Products..
2. Flow Design Inc.
3. Griswold Controls.

B. Coil Piping Package – 1/2" to 2”:
1. Supply Side:
a. Manual air vent with pressure/temperature port.
1) Brass body, EPDM core and O-ring, knurled handle and cap.
2) Side vent with 1/8" hose barb and 1/4" NPT.
3) Extended length.
4) Minimum rating of 250 PSIG at 250°F.
b. Combination Y-strainer with integral pressure/temperature port. Isolation ball valve with extended handle shall be independent from piping package.
1) Forged or cast brass body. EPDM O-ring. Plated steel handle with vinyl grip. Blow out-proof stem. Chrome plated ball with Teflon seats.
2) Strainer with 20 mesh stainless steel screen with removable cap. Strainer shall be fitted with a hose end blow down valve with cap and chain.
3) Minimum rating of 400 PSIG at 250°F.
2. Return Side:
a. Union with pressure/temperature port and manual air vent.
1) Brass O-ring type union. EPDM O-ring. Knurled handle and cap. Blowout-proof stem. Side vent with 1/8" hose barb. 1/4" and 1/2” NPT. Extended length.
2) Minimum Ratings 400 PSIG at 250°F.

b. Integral union with pressure/temperature port. Isolation ball valve with extended handle shall be independent from piping package.
   1) Forged or cast brass body. EPDM O-ring. Plated steel handle with vinyl grip. Blow out-proof stem. Chrome plated ball with Teflon seats.
   2) Minimum rating of 400 PSIG at 250°F.
c. No manual or automatic balancing valves required on main pipe.

C. Coil Piping Package 2-1/2” to 12”:
1. Supply Side:
   a. Manual air vent with pressure/temperature port.
      1) Brass body, EPDM core and O-ring, knurled handle and cap.
      2) Side vent with 1/8" hose barb and 1/4" NPT.
      3) Extended length.
      4) Minimum rating of 250 PSIG at 250°F.
   b. Combination flange end Y-strainer with integral pressure/temperature port. Isolation high performance butterfly valve with extended handle shall be independent from piping package.
      1) Y-strainer shall have cast iron body. Fiber gasket. Stainless steel strainer screen. ANSI 125# Flanged. Strainer shall include pressure/temperature port and drain valve.
      2) High performance butterfly valve shall be lug type with ductile iron body, designed to be installed at inlet of strainer. Resilient seat for bubble tight shut off. Blowout proof stem with pinned disc. Universal mounting flange conforms to ISO-5211. 2.5”-6” supplied with adjustable flow positioning plate. Sizes 8”- 12” provided with a gear operator.
      3) Minimum rating of 175 PSIG at 250°F.
2. Return Side:
   a. Union with pressure/temperature port and manual air vent.
      1) Brass O-ring type union. EPDM O-ring. Knurled handle and cap. Blowout-proof stem. Side vent with 1/8" hose barb. 1/4" and 1/2” NPT. Extended length.
      2) Minimum Ratings 600 PSIG at 250°F.
   b. Integral union with pressure/temperature port. Isolation high performance butterfly valve with extended handle shall be independent from piping package.
      1) High performance butterfly valve shall be lug type with ductile iron body, designed to be installed between all types of ANSI 125/150 flanges. Resilient seat for bubble tight shut off. Blowout proof stem with pinned disc. Universal mounting flange conforms to ISO-5211. 2.5”-6” supplied with adjustable flow positioning plate. Sizes 8”- 12” provided with a gear operator.
      2) Minimum rating of 175 PSIG at 250°F.

D. Flange end pressure/temperature port and manual air vent:
1. Pressure/temperature and manual air vent port.
2. Minimum rating of 175 PSIG at 250°F.

E. Automatic Balancing Valves:
1. Provide automatic balancing valves at pot feeder to maintain minimum flow.
2. Flowrate shall be factory set and shall valve shall automatically limit the rate of flow to within 5% of the specified GPM over at least 95% of the control range.
3. For 3/4” valve, the flow cartridge shall be removable from the Y-body housing without the use of special tools to provide access for cartridge change-out, inspection and cleaning without breaking the main piping.
4. Valve pressure loss shall not exceed seven feet.
5. Valve shall have 2 pressure and temperature ports.
6. The valve handle shall be fitted with a fine tuning memory stop handle to allow for adjusting the control range.

7. The differential pressure across the automatic balancing valve shall be measured for flow verification and to determine the amount of system over heading or under pumping.
8. Provide pressure and temperature test kit with the ability to read differential pressure from 0 to 75 PSIG, and temperature from -10 to 230°F.

2.03 AIR-CONTROL DEVICES

A. Manual Air Vents:
   1. Body: Bronze body ball valve with stainless steel ball, NPS 1/2.
   2. CWP Rating: 150 psig.
   3. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:
   1. Manufacturers:
      a. Bell & Gossett No. 87.
      b. Spirotherm Spirotap Model VTP.
   2. Body: Brass or bronze.
   3. Internal Parts: Nonferrous.
   4. Operator: Noncorrosive metal float.
   5. Inlet Connection: NPS 1/2.
   6. Discharge Connection: NPS 1/4 or 1/2.
   7. CWP Rating: 150 psig.
   8. Maximum Operating Temperature: 240 deg F.

C. Multi-Purpose Tank – buffer tank, air separator, and hydraulic decoupler:
   1. Manufacturers:
      a. Taco Inc.
      b. Bell & Gossett Series B.
      c. Wessels Tank Company Type NLA.
      d. Amtrol L Series.
   2. Tank: Welded steel, rated for 125-psig working pressure and 270 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   3. Provide with seismic restraint.
   4. Provide four system connections that are arranged on the tank in a manner that hydraulically decouples the central plant from the secondary distribution system.
   5. Provide 3/4" sensing port on shell and four 3/4" system connection sensing ports for system pressure and temperature monitoring.
   6. Air Removal Device: brass air venting chamber to minimize system fluid from fouling venting assembly and allow flushing and purging of dirt without dirt passing thru vent on initial system fill.
   7. Fast-Fill Cock: brass flushing cock to facilitate system fast-fill and removal of the floating impurities from the air system interface withing the separator.
   8. Blow-Down Valve: a full port blow-down valve on bottom of unitto allow blow down and cleaning.

D. Bladder-Type ASME Expansion Tanks:
   1. Manufacturers:
      a. Bell & Gossett Series B.
      b. Wessels Tank Company Type NLA.
      c. Amtrol L Series.
   2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   3. Provide with seismic restraint.
   4. Bladder: Heavy duty Butyl securely sealed into tank to separate air charge from system water to maintain required expansion capacity.

5. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

F. Coalescing-Type Air and Dirt Separators:
1. Manufacturers:
a. Bell & Gossett Model CRS.
b. Armstrong Model DAS.
c. Amtrol.
2. Tank: Fabricated steel tank; ASME constructed and stamped for 125-psig working pressure and 450 deg F maximum operating temperature.
3. Coalescing Medium: Stainless steel.
4. Air Vent: Threaded to the top of the separator.
5. Inline Inlet and Outlet Connections: Threaded for NPS 2 and smaller; Class 150 flanged connections for NPS 2-1/2 and larger.
6. Blowdown Connection: Threaded to the bottom of the separator.
7. Size: Match system flow capacity.

2.04 STRAINERS

A. Y-Pattern Strainers up to NPS 1.5:
1. Manufacturers:
a. The Metraflex Company.
b. Keckley.
c. Mueller Steam Specialty.
2. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded.
4. Strainer Screen: 40 mesh stainless-steel screen.
5. CWP Rating: 125 psig.

B. Y-Pattern Strainers NPS 2 and Larger:
1. Manufacturers:
a. The Metraflex Company Model LPD.
b. Or Engineer approved equal.
2. Y-strainer shall be of low pressure drop design with the following Cv values:
a. 2” Pipe 120
b. 2.5” Pipe 160
c. 3” Pipe 236
d. 4” Pipe 460
e. 6” Pipe 952
f. 8” Pipe 1,580
g. 10” Pipe2,424
h. 12” Pipe3,200
3. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection. Strainer shall be suitable for horizontal and vertical mounting.
4. End Connections: Flanged ends.
5. Strainer Screen: Stainless-steel, screen perforations shall be:
a. For liquid service for NPS 2 – 3, perforation shall be 0.045”
b. For liquid service for NPS 4 – 12, perforation shall be 0.125”
6. Pressure Taps: Provide with inlet and outlet pressure plugs.
7. CWP Rating: 125 psig.

C. Basket Strainers:
1. Manufacturers:
a. The Metraflex Company.
b. Keckley.
c. Mueller Steam Specialty.

2. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
4. Strainer Basket: Stainless steel material with perforated sides and solid bottom. Basket to be provided with an integral handle for removal and size of perforations to be appropriate for the media. For water service, 2" thru 3" sizes to have .045 perforations, 4" thru 16" to have .125 perforations.
5. CWP Rating: 125 psig.

2.05 CONNECTORS

A. Spherical, Rubber, Flexible Connectors:
   1. Manufacturers:
      a. The Metraflex Company.
      b. Keckley.
      c. Mueller Steam Specialty.
   2. Body: Fiber-reinforced rubber body.
   3. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
   4. Performance: Capable of misalignment.
   5. CWP Rating: 150 psig.
   6. Maximum Operating Temperature: 250 deg F.

B. Pump Suction Diffusers:
   1. Manufacturers:
      a. The Metraflex Company Suction Diffuser Flex.
      b. Or Engineer approved equal.
   2. Stainless hose, flexible braid, integral rotational vanes, 90° reducing elbow and flanged connection.
      a. Flexible hose section to be 304 stainless steel, close pitch, annular corrugated hose with a type 304 braided outer covering.
      b. End connections to be ANSI class 150 carbon steel plate flanges.
      c. Overall length to allow for a minimum of 6" intermittent flexing.
   3. Connectors shall be located upstream of the inlet elbow, and incorporate specially designed stationary vanes that impart a rotational motion as the fluid enters the elbow. Vanes to be capable of counteracting elbow induced turbulence, enabling the fluid to negotiate the turn uniformly, and exit with a flat velocity profile.

C. Pump Discharge Connections:
   1. Manufacturers:
      a. The Metraflex Company Vane Flex.
      b. Or Engineer approved equal.
   2. Stainless hose, flexible braid, integral straightening vanes and flanged connection.
      a. Flexible hose section to be 304 stainless steel, close pitch, annular corrugated hose with a type 304 braided outer covering.
      b. End connections to be ANSI class 150 carbon steel plate flanges.
      c. Overall length to allow for a minimum of 6" intermittent flexing.
   3. Connectors shall incorporate internal flow straightening vanes to reduce turbulence prior to the balancing valve. Vanes to be capable of reducing discharge turbulence equal to 5-10 pipe diameters of straight pipe, while allowing full rated movement of the connector.

PART 3 EXECUTION

3.01 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install pressure independent control valves in the return water line of each cooling element.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.02 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install pump suction diffusers at all suction pump connections and pump discharge flexible connections with straightening vanes to relieve pump and piping stresses and straighten flow.

D. Install piping from boiler air separator to expansion tank with a 2 percent upward slope toward tank.

E. Install one coalescing-type air and dirt separator per system. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

F. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

3.03 TERMINAL EQUIPMENT CONNECTIONS

A. Provide flexible pipe connection to and from terminal, VAV or lab boxes.

B. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

C. Install control valves in accessible locations close to connected equipment.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 23 05 19 "Meters and Gages for HVAC Piping."

END OF SECTION 23 21 16

SECTION 23 21 23
HYDRONIC PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Close-coupled, in-line centrifugal pumps.

B. Separately coupled, base-mounted, end-suction centrifugal pumps.

1.02 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.03 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

C. Shop Drawings: For each pump.
   1. Show pump layout and connections.
   2. Include setting drawings with templates for installing foundation, anchor bolts and other anchorages.
   3. Include diagrams for power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Mechanical Seals: One mechanical seal for each pump.

PART 2 PRODUCTS

2.01 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS (P-1A, 1B, 3, 4A, 4B AND 6)

A. Manufacturers:
   1. Taco Inc.
   2. Armstrong Pumps, Inc.
   3. Aurora Pumps.
   4. ITT Corporation; Bell & Gossett.
   5. Paco Pumps.

B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.

C. Pump Construction:
   1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange connections.
   2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
   3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
   4. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
   5. Pump Bearings: Permanently lubricated ball bearings.

D. Motor: Single speed and rigidly mounted to pump casing.
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
   3. Capacities and Characteristics: Shown in Pump Schedule on Drawings.

2.02 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS (P-2 AND P-5)

A. Manufacturers:
   1. Taco Inc.
   2. Armstrong Pumps, Inc.
   3. Aurora Pumps.
   4. ITT Corporation; Bell & Gossett.
   5. Paco Pumps.

B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.

C. Pump Construction:
   1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections. Provide integral mount on volute to support the casing, and provide attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.
   2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
   3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
   4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket.
   5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
   6. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.

D. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration. EPDM coupling sleeve for variable-speed applications.

E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

G. Motor: Single speed and rigidly mounted to pump casing.
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

H. Capacities and Characteristics: Shown in Pump Schedule on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine all pumps before installation. Reject pumps that are damaged.

B. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

C. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

D. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Equipment Mounting:
   1. Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
   2. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
   3. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."

E. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support weight of in-line pumps.
   1. Comply with requirements for seismic-restraint devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
   2. Comply with requirements for hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

3.03 ALIGNMENT

A. Engage a factory-authorized service representative to perform alignment service.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."
   1. Alignment shall be reverse dial indicator or laser method.
   2. Indicated run-out shall not exceed 0.001 inches.
   3. Angular and offset misalignment shall be as follows:

	Maximum Angularity	Maximum Offset
1200 rpm	0.0015”	0.001”

	Maximum Angularity	Maximum Offset
1800 rpm	0.0010”	0.001”
3600 rpm	0.0005”	0.001”

E. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.04 CONNECTIONS

A. Comply with requirements for piping specified in Section 23 21 13 "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check and shutoff valves on discharge side of pumps. A check valve is not required in a single pump configuration.

F. Install strainer or suction diffuser and shutoff valve on suction side of pumps.

G. Install flexible connectors with vane straighteners on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping.

I. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Perform the following startup checks for each pump before starting:
      a. Verify bearing lubrication.
      b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
      c. Verify that pump is rotating in the correct direction.
   5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
   6. Start motor.
   7. Open discharge valve slowly.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Contracting Agency's maintenance personnel to adjust, operate, and maintain hydronic pumps as specified below:
   1. Train University's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.
   2. Review data in maintenance manuals.
   3. Schedule training with Contracting Agency.

END OF SECTION 23 21 23

SECTION 23 25 13

WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The following water treatment for closed-loop hydronic systems:
   1. Automatic chemical-feed equipment.
   2. Chemicals.

1.02 RELATED REQUIREMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.03 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

B. RO: Reverse osmosis.

C. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

D. MSDS: Material Safety Data Sheets.

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:
   1. Bypass feeders.
   2. Water meters.
   3. Inhibitor injection timers.
   4. pH controllers.
   5. TSS controllers.
   6. Chemical solution tanks.
   7. Injection pumps.
   8. Chemical test equipment.
   9. Chemical MSDS.

C. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to hydronic systems.
   1. Include plans, elevations, sections, and attachment details.
   2. Include diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For components, from manufacturer. (Not needed if provided by SEOR)
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Water Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.

C. Field quality-control reports.

D. Other Informational Submittals:
1. Water-Treatment Program: Written sequence of operation on an annual basis for the application and equipment required to achieve water quality defined in "Performance Requirements" Article.
2. Water Analysis: Illustrate water quality available at Project site.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

B. HVAC Water-Treatment Service Provider shall provide 10 years of documented experience if requested.

1.08 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion and scale formation for hydronic piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion and shall include the following:
1. Initial water analysis and HVAC water-treatment recommendations.
2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
3. Periodic field service and consultation.
4. Customer report charts and log sheets.
5. Laboratory technical analysis.
6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nalco.

B. Trident Water Technologies.

C. McKinstry.

D. Garratt-Callahan.

E. Mt. Hood Solutions (formerly CHEMCOA).

2.02 PERFORMANCE REQUIREMENTS

A. Water quality for hydronic systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of hydronic equipment without creating a hazard to operating personnel or the environment.

B. The water treatment program shall include:
1. Pre-treatment clean and flush.
2. Passivation.
3. Inhibitor.

4. For remodel project where only a portion of the building is being renovate, the new supply and return piping shall be isolated from the rest of the facility, pre-treated and flushed and passivated. Once passivation is complete the new piping shall be opened to the existing facility loop to be treated with inhibitor.
    a. Provide temporary chemical feed equipment, piping, valves tanks etc. as required to introduce cleaning, degreasing and chemicals for passivation of the piping system.
    b. Provide temporary pump to circulate the water at a minimum of 5 feet per second.
    c. Coordinate supply and return point of connections indicated on the plans with the mechanical contractor.

C. Design HVAC water treatment program on quality of water available at Project site, hydronic system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

D. Closed hydronic systems, including heating water and condenser water, shall have the following water qualities:
1. pH: Maintain a value within 9.0 to 10.5.
2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
3. Boron: Maintain a value within 100 to 200 ppm.
4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
6. TSS: Maintain a maximum value of 10 ppm.
7. Ammonia: Maintain a maximum value of 20 ppm.
8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
9. Microbiological Limits:
    a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
    b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
    c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
    d. Sulfate Reducers: Maintain a maximum value of zero organisms/mL.
    e. Iron Bacteria: Maintain a maximum value of zero organisms/mL.

2.03 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
1. Capacity: 5 gal.
2. Minimum Working Pressure: 125 psig.

2.04 AUTOMATIC CHEMICAL-FEED EQUIPMENT

A. Water Meter:
1. AWWA C700, oscillating-piston, magnetic-drive, totalization meter.
2. Body: Bronze.
3. Minimum Working-Pressure Rating: 150 psig.
4. Maximum Pressure Loss at Design Flow: 3 psig.
5. Registration: Gallons.
6. End Connections: Threaded.
7. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac; and that will close at adjustable increments of total flow.
8. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Water Meter:
1. AWWA C701, turbine-type, totalization meter.
2. Body: Bronze.
3. Minimum Working-Pressure Rating: 150 psig.

4. Maximum Pressure Loss at Design Flow: 3 psig.
5. Registration: Gallons.
6. End Connections: Flanged.
7. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac; and that will close at adjustable increments of total flow.
8. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Chemical Solution Tanks:
1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.
2. Molded cover with recess for mounting pump.
3. Capacity: 50 gal.

D. Chemical Solution Injection Pumps:
1. Self-priming, positive displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
2. Adjustable flow rate.
3. Metal and thermoplastic construction.
4. Built-in relief valve.
5. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints except ASTM A 269, Type 304, stainless steel for steam boiler injection assemblies.

F. Injection Assembly:
1. Quill: Minimum NPS 1/2 with insertion length sufficient to discharge into at least 25 percent of pipe diameter.
2. Ball Valve: Two-piece, stainless steel; selected to fit quill.
3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.
4. Assembly Pressure/Temperature Rating: Minimum 600 psig at 200 deg F.

2.05 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment and that can attain water quality specified in "Performance Requirements" Article.

B. All chemicals and cleaners used shall NOT contain any ammonia-based chemicals, nor any phosphates or phosphorous-based chemicals.
1. Pre-treatment Clean and Flush:
a. Neutral pH product to maintain a pH of 7.0-8.0 in the new piping and coil system. It should not contain any ammonia or phosphate products.
b. Or approved equal
2. Passivator:
a. Chilled Water:
1) pH 8.5 to 10.5.
2) Nitrite at 1,000-1200 ppm.
3) Molybdate at 400 ppm +/- 100-120 ppm.
4) Azole at 40 ppm +/- 10-20 ppm.
5) Or approved equal.
b. Hot Water.
1) pH 8.5 to 10.5.
2) Sodium Nitrite 1,000-1200ppm.

3) Azole at 40 ppm +/- 10-20 ppm.
4) Or approved equal.

3. Inhibitor:
   a. Nitrite based closed circuit corrosion and scale inhibitor.

C. If tied into a thermal energy storage (TES) system, use molybdenum based closed circuit corrosion and scale inhibitor.

PART 3 EXECUTION

3.01 GENERAL

A. If the system is hydrotested before being cleaned and passivated, the hydrotest water shall be city water or its equivalent, and the system shall be cleaned and passivated within three (3) calendar days.

B. The hydronic piping systems must be protected by 30% propylene glycol.

3.02 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

B. Water samples taken during each step shall be analyzed, at least, for the pH, conductivity, copper, iron, total alkalinity, phosphate, total hardness, and chlorides. Additional tests shall be taken as noted in this procedure.

3.03 PREPARATION

A. Hydronic piping test for leaks and defects shall be completed prior to the HVAC water treatment is to begin. If testing is performed in segments, submit separate pressure test report for each segment, complete with diagram of portion of piping tested.

B. Do not enclose, cover, or put piping into operation until it is tested, and satisfactory test results are achieved.

3.04 INSTALLATION

A. Install in accordance with the HVAC Water Treatment Providers recommendations.
   1. Temporary Circulation Pumps
      a. Coordinate with the Mechanical Contractor the configuration of any temporary pumps, chemical feed equipment, valves and piping for the chemical cleaning and passivation.
      b. Provide pumps, piping connections and shut-off valves between HVAC water-treatment equipment and the piping to allow for the circulation of the water treatment at minimum of 5 FPS velocities.
      c. Provide backflow preventers as required for temporary makeup-water fill connections to potable-water systems.
      d. The temporary system shall be operational, filled, started and vented prior to cleaning.
      e. Mechanical Contractor shall coordinate with the Contracting Agency and the Contracting Agency’s existing HVAC Water-Treatment Service Provider to schedule the water treatment and final fill requirements.

B. Install chemical treatment equipment on 4” thick minimum concrete housekeeping pads, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

C. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. Comply with requirements in Section 23 05 48 "Vibration and Seismic Controls for HVAC" for seismic restraints.

D. Install water testing equipment on wall near water chemical application equipment.

E. Install interconnecting control wiring for chemical treatment controls and sensors.

F. Mount sensors and injectors in piping circuits. Coordinate with mechanical contractor.

3.05 PIPING CONNECTIONS

A. Piping installation requirement are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Section 23 21 13 "Hydronic Piping."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Section 23 05 23.11 "Globe Valves for HVAC Piping," Section 23 05 23.12 "Ball Valves for HVAC Piping," Section 23 05 23.13 "Butterfly Valves for HVAC Piping," and Section 23 05 23.15 "Gate Valves for HVAC Piping."

E. Comply with requirements in Section 22 11 19 "Domestic Water Piping Specialties" for backflow preventers required in makeup-water connections to potable-water systems.

3.06 ELECTRICAL CONNECTIONS

A. Confirm applicable electrical requirements in electrical Sections for connecting electrical equipment.

B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.07 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
   2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
   3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of hydronic systems' startup procedures.
   4. Do not enclose, cover, or put piping into operation until it is tested, and satisfactory test results are achieved.
   5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
   7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
   8. Repair leaks and defects with new materials and retest piping until no leaks exist.

C. Equipment will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. At four-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water

analysis advising Contracting Agency of changes necessary to adhere to "Performance Requirements" Article.

F. Comply with ASTM D 3370 and with the following standards:
   1. Silica: ASTM D 859.
   2. Acidity and Alkalinity: ASTM D 1067.
   3. Iron: ASTM D 1068.
   4. Water Hardness: ASTM D 1126.

3.08 WATER TREATMENT SEQUENCE

A. Pre-Treatment and Flush
   1. This step should be done within 24-hours of the disinfection procedure.
   2. Isolate existing piping from new piping so as to circulate solution in the newly installed pipe system ONLY.
   3. Contractor shall provide valves and piping as necessary to bypass the existing water systems.
   4. Add sufficient neutral-based cleaner, as recommended by the manufacturer, to the system and/or coils water, and circulate for 24-36 hours at full flow.
   5. Drain and refill and flush the system with city water for at least one (1) hour or until the rinse water is clean of any particulates or oil. Continue the flushing procedure until the water is equivalent to city water.
   6. At the end of the cleaning, take and analyze water samples as noted in the notes section above.

B. Passivation
   1. Start passivation at the end of the cleaning cycle, no longer than six (6) hours later.
   2. Add the passivation chemical to the system and circulate for six (6) hours, but test after two (2) hours for nitrate or molybdate and azole levels to ensure the required levels are reached, as shown in the notes section above. If the levels are below the required levels, then add additional chemicals and retest in another two (2) hours. Repeat until the proper levels are reached. Once the proper levels are reached, circulate for six (6) hours.
   3. At the end of passivation, take and test water samples for the nitrate or molybdate and azole levels.
   4. Once approved, the new system and/or coils may be tied into the campus TES chilled water and/or heating hot water system.

C. Inhibitor
   1. Start inhibitors at the end of the cleaning cycle, no longer than six (6) hours later.
   2. Add the inhibitors chemical to the system and circulate for six (6) hours, but test after two (2) hours inhibitor levels. If the levels are below the required levels, then add additional chemicals and retest in another two (2) hours. Repeat until the proper levels are reached.
   3. After adding inhibitor, take and test water samples for the nitrate or molybdate and azole levels.

D. Once approved, the new system and/or coils may be tied into the campus chilled water and/or heating hot water system.

3.09 RECORDS MANAGEMENT

A. A copy of this procedure shall be kept in the Procedures Manual maintained by the FM Director’s Assistant.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Contracting Agency's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

B. Provide (8) hours of training for the Contracting Agency’s maintenance personnel and video record the training. Provide three DVD copies of the training to the Contracting Agency.

END OF SECTION 23 25 13

This page intentionally left blank

SECTION 23 31 13
METAL DUCTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single-wall rectangular ducts and fittings.

B. Single-wall round and flat-oval ducts and fittings.

C. Sheet metal materials.

D. Duct liner.

E. Sealant and gaskets.

F. Hangers and supports.

G. Seismic-restraint devices.

1.02 RELATED REQUIREMENTS

A. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.

B. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.03 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
   1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.05 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of the following products:
   1. Liners and adhesives.
   2. Sealants and gaskets.
   3. Seismic-restraint devices.

C. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory- and shop-fabricated ducts and fittings.

3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

D. Delegated-Design Submittal:
1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations, including analysis data signed and sealed by the licensed structural engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.07 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

D. Exhaust system shall comply with IMC Chapter 5.

E. ASHRAE/IESNA 90.1 requires leakage testing for representative sections totaling no less than 25 percent of installed duct area for ducts designated to operate at a static-pressure class in excess of 3-inch wg . Consider building a mockup of typical portions of the system that can be tested early in the construction process. This standard, as enforced by some authorities having jurisdiction, requires duct systems with static-pressure classes in excess of 3-inch wg to be identified on Drawings.

PART 2 PRODUCTS

2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
   1. Factory- or shop-fabricated spiral lock seam duct:
      a. No snap lock.
      b. Factory-fabricated longitudinal seam acceptable for ducts larger than standard factory sizes.
   2. Manufacturers:
      a. United Sheet Metal Division, United McGill.
      b. Semco Manufacturing, Inc.
      c. Or equal.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Fittings:
1. Same material and construction as duct in which installed
2. For ductwork exposed to occupant view, do not use fabricated fittings at taps to terminal units and outlets. Instead use saddle tap cut into continuous spiral duct. Intent is for spiral duct to be continuous for aesthetic reasons. Saddle tap flange width shall be 0.5 inches or less.

F. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.03 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. General Applications (except as noted below): G60 Galvanized Coating.
2. Plenum Walls and Blank-Offs Where in Contact with Cooling Coil: G90 Galvanized Coating.
3. Exterior Applications: G90 Galvanized Coating.
4. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G90
2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings, and minimum 1 mil thick on opposite surface.
3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304L or 316L, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

F. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

G. Factory- or Shop-Applied Antimicrobial Coating:
1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
5. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

H. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

I. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.04 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. CertainTeed Corporation; Insulation Group.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Maximum Thermal Conductivity:
         1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
         2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
      a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Armacell LLC.
      b. Aeroflex USA Inc.
      c. Rubatex International, LLC.
   2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
   3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
      a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Insulation Pins and Washers:
   1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick stainless steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
   1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
   2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
   3. Butt transverse joints without gaps, and coat joint with adhesive.
   4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
   5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
   6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
   7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
   8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
      a. Fan discharges.
      b. Intervals of lined duct preceding unlined duct.
      c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
   9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
      a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
   10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.05 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
   1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
   2. Tape Width: 3 inches.
   3. Sealant: Modified styrene acrylic.
   4. Water resistant.
   5. Mold and mildew resistant.
   6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   7. Service: Indoor and outdoor.
   8. Service Temperature: Minus 40 to plus 200 deg F.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
12. Service: Indoor or outdoor.
13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.06 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.07 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Hilti Corp.
2. TOLCO; a brand of NIBCO Inc.
3. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by the Office of Statewide Health Planning and Development for the State of California.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Reinforcing steel angle or channel unistrut clamped to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 EXECUTION

3.01 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers as required by NFPA 90A. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.02 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

F. Seal ductwork with clear sealant in office areas.

3.03 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
   1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   2. Outdoor, Supply-Air Ducts: Seal Class A.
   3. Outdoor, Exhaust Ducts: Seal Class B.
   4. Outdoor, Return-Air Ducts: Seal Class A.
   5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 1-Inch wg and Lower: Seal Class B.
   6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 1-Inch wg: Seal Class A.
   7. Unconditioned Space, Exhaust Ducts: Seal Class B.
   8. Unconditioned Space, Return-Air Ducts: Seal Class A.

9. Conditioned Space, Supply-Air Ducts in Pressure Classes 1-Inch wg and Lower: Seal Class B.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 1-Inch wg: Seal Class A.
11. Conditioned Space, Exhaust Ducts: Seal Class A.
12. Conditioned Space, Return-Air Ducts: Seal Class A.

3.04 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.05 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
   1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
   2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an evaluation service member of the ICC Evaluation Service.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.06 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.07 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 09 90 00 "Painting and Coating."

3.08 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
   1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
   2. Test the following systems:
      a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Engineer from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Test for leaks before applying external insulation.
   5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
   6. Give seven days advance notice for testing.

C. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.

D. Contractor shall develop and implement an IAQ Management Plan for the construction and pre-occupancy phases of the building as follows:
   1. During construction meet or exceed the recommended control measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, and Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3).
   2. Protect stored materials on-site and installed absorptive materials from moisture damage.
   3. If permanently installed air handlers are used during construction, then filtration media with a minimum efficiency reporting value (MERV) of 8 must be used at each return air grille, as determined by ASHRAE Standard 52.2-2012 (with errata, but without addenda). Replace air filtration media immediately prior to occupancy.

E. Duct system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.09 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.
   1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 33 00 "Air Duct Accessories" for access panels and doors.
   2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
   3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:
   1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
   2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:
   1. Air outlets and inlets (registers, grilles, and diffusers).
   2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
   3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
   4. Coils and related components.
   5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
   6. Supply-air ducts, dampers, actuators, and turning vanes.
   7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:
   1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
   2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
   3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
   4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
   5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
   6. Provide drainage and cleanup for wash-down procedures.
   7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.

B. Supply Ducts:
   1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
      a. Pressure Class: Positive 1-inch wg.
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 8.
      d. SMACNA Leakage Class for Round and Flat Oval: 4.
   2. Ducts Connected to Constant-Volume Air-Handling Units:
      a. Pressure Class: Positive 3-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 4.
      d. SMACNA Leakage Class for Round and Flat Oval: 2.
   3. Ducts Connected to Equipment Not Listed Above:
      a. Pressure Class: Positive 2-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 4.
      d. SMACNA Leakage Class for Round and Flat Oval: 2.

C. Return Ducts:
   1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
      a. Pressure Class: Positive or negative 1-inch wg.
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 8.
      d. SMACNA Leakage Class for Round and Flat Oval: 4.
   2. Ducts Connected to Air-Handling Units:
      a. Pressure Class: Positive or negative 3-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 4.
      d. SMACNA Leakage Class for Round and Flat Oval: 2.
   3. Ducts Connected to Equipment Not Listed Above:
      a. Pressure Class: Positive or negative 2-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 4.
      d. SMACNA Leakage Class for Round and Flat Oval: 2.

D. Exhaust Ducts:
   1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Negative 2-inch wg.
      b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
      c. SMACNA Leakage Class for Rectangular: 4.
      d. SMACNA Leakage Class for Round and Flat Oval: 2.
   2. Ducts Connected to Air-Handling Units:
      a. Pressure Class: Positive or negative 3-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 4.
      d. SMACNA Leakage Class for Round and Flat Oval: 2.
   3. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:
      a. Type 316L, stainless-steel sheet.
         1) Exposed to View: No. 4 finish.
         2) Concealed: No. 2D finish.
      b. PVC-coated, galvanized sheet steel with thicker coating on duct interior.

c. Pressure Class: Positive or negative 4-inch wg.
d. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
e. SMACNA Leakage Class: 3.

4. Ducts Connected to Equipment Not Listed Above:
a. Pressure Class: Positive or negative 3-inch wg.
b. Minimum SMACNA Seal Class: A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 4.
d. SMACNA Leakage Class for Round and Flat Oval: 2.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4.
d. SMACNA Leakage Class for Round and Flat Oval: 2.
2. Ducts Connected to Air-Handling Units:
a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4.
d. SMACNA Leakage Class for Round and Flat Oval: 2.
3. Ducts Connected to Equipment Not Listed Above:
a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4.
d. SMACNA Leakage Class for Round and Flat Oval: 2.

F. Liner:
1. Supply Air Ducts: Fibrous glass, Type I, 1-1/2 inches thick.
2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
3. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

G. Double-Wall Duct Interstitial Insulation:
1. Supply Air Ducts: 2 inches thick.
2. Return Air Ducts: 2 inches thick.
3. Exhaust Air Ducts: 2 inches thick.

H. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
a. Velocity 1000 fpm or Lower:
1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Mitered Type RE 4 with single-thickness turning vanes.
b. Velocity 1000 to 1500 fpm:
1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and single-thickness turning vanes.
3) Mitered Type RE 2 with single-thickness vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
c. Velocity 1500 fpm or Higher:
1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.5 radius-to-diameter ratio and single-thickness turning vanes.

3) Mitered Type RE 2 with single-thickness vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and single-thickness turning vanes.
   c. Mitered Type RE 2 with single-thickness vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Velocity 1000 fpm or Lower: 1.0 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm: 1.5 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      4) Radius-to Diameter Ratio: 1.5.
   b. Round Elbows, 10 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 12 Inches and Larger in Diameter: Welded.

I. Branch Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
      a. Rectangular Main to Rectangular Branch: 45-degree entry.
      b. Rectangular Main to Round Branch: Spin in.
   2. Taps shall be the more stringent of what is shown on the mechanical drawings and the criteria listed below. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
      a. Velocity 900 fpm or Lower: 90-degree tap.
      b. Velocity 901 to 1500 fpm: Conical tap.
      c. Velocity 1501 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

This page intentionally left blank

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Backdraft and pressure relief dampers.

B. Barometric relief dampers.

C. Manual volume dampers.

D. Combination fire and smoke dampers.

E. Flange connectors.

F. Remote damper operators.

G. Duct-mounted access doors.

H. Flexible connectors.

I. Duct accessory hardware.

1.02 RELATED REQUIREMENTS

A. Section 23 33 46 "Flexible Ducts" for insulated and non-insulated flexible ducts.

B. Section 23 37 23 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.

C. Section 28 46 21.11 "Addressable Fire-Alarm Systems" for duct-mounted fire and smoke detectors.

1.03 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.
   1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

C. Sustainable Design Submittals:
   1. Product data showing compliance with ASHRAE 62.1.

D. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
   1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
      a. Special fittings.
      b. Manual volume damper installations.
      c. Combination fire- and smoke-damper, including sleeves; and duct-mounted access doors and remote damper operators.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 PRODUCTS

2.01 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.02 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G60.
   2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2D finish for concealed ducts and No. 4 finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.03 BACKDRAFT AND PRESSURE RELIEF DAMPERS

1. Manufactures shall be Ruskin, Greenheck or equal.

B. Frame: 8 inches x minimum 0.125 inch 6063-T5 extruded aluminum channel with front flange and galvanized steel braces at mitered corners.

C. Blades:
   1. Style: 2V.
   2. Action: Parallel.
   3. Orientation: Horizontal.
   4. Material: Minimum 0.070 inch 6063-T5 extruded aluminum.
   5. Width: Maximum 6 inches.

D. Bearings: Galvanized Steel Ball Axle Bearings.

E. Blade Seals: Extruded vinyl, mechanically attached to blade edge.

F. Linkage: External heavy duty type with steel clevis arms and plated steel tie bars & pivot pins with nylon pivot bearings.

G. Axles: Galvanized steel.

H. Counterbalances: Adjustable externally mounted counterbalance weights mechanically attached to blade enabling damper to operate over wide range of pressures.

I. Finish: Mill aluminum.

J. Performance Data:
   1. Temperature Rating: Withstand -20° to 180°F.
   2. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.
      a. Closed Position: Maximum differential pressure of 5 inches w.g..
      b. Open Position: Maximum air velocity of 3,900 feet per minute.
   3. Pressure Drop: Maximum 0.3 inch w.g. at 10,000 CFM through 36 inch x 36 inch damper.

2.04 BAROMETRIC RELIEF DAMPERS

A. Manufactures shall be Ruskin, Greenheck or equal.

B. Construction:
   1. Frame: Damper frame shall be 16 ga. Galvanized steel. Aluminum or 304 stainless steel is an option.
   2. Blades: Damper blades shall be a minimum 0.063 inch thick aluminum.
   3. Blade Stops: Each blade stop (at top and bottom of damper frame) shall occupy no more than 3 1/2” of the damper opening area to allow for maximum free area and to minimize pressure loss across the damper.
   4. Seals:
   5. Blade Edge: Vinyl is standard. None is an option.
   6. Jamb: None is standard. EPDM is an option.
   7. Linkage: External, steel tie bars
   8. Axles: Plated steel stub axles are standard. Stainless steel is optional.
   9. Bearings: Galvanized steel press fit. Acetal with stainless steel ball is optional
   10. Finish: Mill finish. Paint coatings are optional.
   11. Counterbalance: Blade mounted with adjustable weights.

2.05 MANUAL VOLUME DAMPERS

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.

B. Fabricate splitter dampers of material same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.

C. Fabricate splitter dampers of single thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4 inch diameter rod in self aligning, universal joint action flanged bushing with set screw.

D. Fabricate single blade dampers for duct sizes to 12 x 48 inch.

E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends.

H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

2.06 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:
   1. Greenheck Type FSD-212 or equal for 1500 feet per minute and below.
   2. Greenheck Type FSD-311 or equal for above 1500 feet per minute.
   3. Or equal by Ruskin or Pottoff.

B. Combination Smoke/Fire Dampers shall be furnished and installed at all locations shown on the plans and/or as described on the drawing details and suitable for closure against duct operating pressure up to Design Static Pressure class.

C. Damper shall meet the requirements of NFPA 90A, 92A, and 92B and further shall be tested, rated and labeled in accordance with the latest edition on UL Standard 555 and 555S. Dampers shall be UL rated per the CBC 717.3.1.

D. Damper shall be of low leakage design qualified to UL 555S Leakage Class II.
   1. Damper actuator combination shall have a UL 555S elevated temperature rating of 350 degrees Fahrenheit minimum and shall be operational and dynamic rated to operate at maximum design airflow rate at its installed location.
   2. Damper shall be supplied with an appropriate actuator installed by the damper manufacturer at the time of damper fabrication. Damper actuator shall be electric type for 120-volt operation.
   3. Damper blades shall be 16-gauge galvanized steel 3 Vee type with three longitudinal grooves for reinforcement. Damper frame shall be galvanized steel formed into a structural hat channel shape with reinforced corners. Bearing shall be sintered bronze sleeve type rotating in extruded holes in the damper frame. Blade seals shall be silicone rubber designed to inflate and provide a tighter seal against leakage as pressure on either side of the damper increases. Jamb seals shall be stainless steel compression type with silicone rubber backing. Blades shall be completely symmetrical relative to their axle pivot point, presenting identical resistance to airflow in either direction or pressure on either side of the damper.
   4. Damper must be rated for mounting vertically (with blades running horizontally) or horizontally and be UL 555S rated for leakage and airflow in either direction through the damper.
   5. Damper shall be supplied with a 165-degree Fahrenheit fusible link. Provide access doors at either side of the combination smoke/fire damper for viewing of the fusible links.
   6. The specified combination smoke/fire damper shall meet the requirements for fire dampers, smoke dampers and combination fire smoke dampers established by:
   7. National Fire Protection Association NFPA Standard 90A, 92A, 92B and 101
   8. Underwriters Laboratories Standard 555 Listing #R-13317
   9. Underwriters Laboratories Standard 555S Listing #R-13447
   10. California State Fire Marshall CSFM Fire Damper Listing #3225-0981:103
   11. California State Fire Marshall CSFM Leakage Smoke Damper Listing #3230-0981:104
   12. Smoke Detector will be provided by the electrical contractor to be compatible with the fire alarm system. Mechanical contractor shall install all duct-mounted smoke detectors. Electrical contractor shall connect smoke detector to smoke dampers and fire alarm panel. After installation is complete, electrical contractor shall test and verify that smoke detectors are active and functional.

2.07 FLANGE CONNECTORS

A. Manufacturer shall be Ductmate, CL WARD, or equal.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.08 REMOTE DAMPER OPERATORS

A. Manufacturer shall be Young Regulator, Pottorff or equal.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Mounting: Recessed.

F. Wall-Box Cover Plate Material: Stainless Steel.

2.09 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers shall be Ventfrabrics, Ductmate, Pottorf Company or equal.

B. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards and as indicated.

C. Review locations prior to fabrication.

D. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.

E. Access doors smaller than 12 inches square may be secured with sash locks.

F. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.

G. Access doors with sheet metal screw fasteners are not acceptable.

2.10 FLEXIBLE CONNECTORS

A. Manufacturer: Ventfrabrics, Duro Dyne or equal.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
   1. Minimum Weight: 24 oz./sq. yd.
   2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
   3. Service Temperature: Minus 50 to plus 250 deg F.

G. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
   1. Minimum Weight: 14 oz./sq. yd.
   2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
   3. Service Temperature: Minus 67 to plus 500 deg F.

H. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
   1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.

2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.11 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Compliance with ASHRAE/IESNA 90.1-2004 includes Section 6.4.3.3.3 - "Shutoff Damper Controls," restricts the use of backdraft dampers, and requires control dampers for certain applications. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. On both sides of duct coils.
   2. At outdoor-air intakes and mixed-air plenums.
   3. At drain pans and seals.
   4. Downstream from backdraft dampers.
   5. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
   6. At each change in direction and at maximum 50-foot spacing.
   7. Upstream or downstream from duct silencers.
   8. Control devices requiring inspection.
   9. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:
   1. One-Hand or Inspection Access: 8 by 5 inches
   2. Two-Hand Access: 12 by 6 inches
   3. Head and Hand Access: 18 by 10 inches
   4. Head and Shoulders Access: 21 by 14 inches
   5. Body Access: 25 by 14 inches
   6. Body plus Ladder Access: 25 by 17 inches

K. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Where indicated on Drawings, connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

O. Connect flexible ducts to metal ducts with draw bands.

P. Install duct test holes where required for testing and balancing purposes.

Q. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Operate dampers to verify full range of movement.
   2. Inspect locations of access doors and verify that purpose of access door can be performed.
   3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
   4. Inspect turning vanes for proper and secure installation.
   5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

This page intentionally left blank

SECTION 23 34 23
HVAC FANS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Utility set fans.

B. Centrifugal roof ventilators.

C. Centrifugal wall ventilators.

1.02 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.
   6. Roof curbs.
   7. Fan speed controllers.

C. Shop Drawings:
   1. Include plans, elevations, sections, and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC fans to include in emergency, operation, and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Belts: One set(s) for each belt-driven unit.

1.07 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: HVAC fans shall comply with UL 705. HVAC fans for use for restaurant kitchen exhaust shall also comply with UL 762.

1.08 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

D. Provide access around equipment as specified on plans and/or according to manufacturer’s requirements.

1.09 WARRANTY

A. Manufacturer's Warranty: Submit, for Contracting Agency's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Contracting Agency may have under Contract Documents

B. The warranty of this equipment is to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at the Manufacturers option when returned to Manufacturer, transportation prepaid.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Unusual Service Conditions
   1. Base fan-performance ratings on the following:
      a. Ambient Temperature: 70 deg F.
      b. Altitude: 0 feet above sea level.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design vibration isolation and seismic restraints, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Seismic Performance: HVAC power ventilators shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Component Importance Factor: 1.0.

2.02 UTILITY SET FANS

A. Manufacturers:
   1. Greenheck Fan Company.
   2. Loren Cook Company.
   3. PennBarry
   4. Twin City Fans

B. Housing: Fabricated of galvanized steel with side sheets fastened with a deep lock seam or welded to scroll sheets.
   1. Housing Discharge Arrangement: Adjustable to eight standard positions.

C. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.
   1. Blade Materials: Steel.
   2. Blade Type: Backward inclined.
   3. Spark-Resistant Construction: AMCA 99, Type B.

D. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

E. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L_{50} of 200,000 hours.
   1. Extend grease fitting to accessible location outside of unit.

F. Belt Drives:
   1. Factory mounted, with final alignment and belt adjustment made after installation
   2. Service Factor Based on Fan Motor Size: 1.5.
   3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
   4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
   5. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

G. Accessories:
   1. Inlet and Outlet: Flanged.
   2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
   3. Access Door: Gasketed door in scroll with latch-type handles.
   4. Drain Connections: NPS 3/4 threaded coupling drain connection installed at lowest point of housing.
   5. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.

2.03 CENTRIFUGAL VENTILATORS - ROOF DOWNBLAST

A. Manufacturers:
   1. Greenheck Fan Company.
   2. Loren Cook Company.
   3. PennBarry
   4. Twin City Fans

B. Housing: Downblast; removable spun aluminum square, one-piece aluminum base with venturi inlet cone.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Accessories:
   1. Direct Drive Motor: Provide ECM motor to reduce speed from 100 to less than 50 percent.
   2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
   3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
   4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

E. Prefabricated Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
   1. Overall Height: 18 inches.
   2. Pitch Mounting: Manufacture curb for roof slope.

2.04 CENTRIFUGAL VENTILATORS - SIDEWALL

A. Manufacturers:
   1. Greenheck Fan Company.
   2. Loren Cook Company.
   3. PennBarry
   4. Twin City Fans

B. Configuration: Centrifugal sidewall ventilator.

C. Housing: Removable spun aluminum; square, one-piece aluminum base with venturi inlet cone.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Accessories:
   1. Direct Drive Motor: Provide ECM motor to reduce speed from 100 to less than 50 percent.
   2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
   3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
   4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
   5. Wall Mount Adapter: Attach wall-mounted fan to wall.

2.05 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.06 SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. AMCA Certification: Fans shall comply with AMCA 11 and bear the AMCA-Certified Ratings Seal.

C. Fan Sound Ratings: Comply with AMCA 311, and label fans with the AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. The fans shall be tested according to AMCA 300.

D. Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. The fans shall be tested for air performance - flow rate, fan pressure, power, fan efficiency, air density, speed of rotation, and fan efficiency - according to AMCA 210/ASHRAE 51.

E. Operating Limits: Classify according to AMCA 99.

F. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install HVAC fans level and plumb.

B. Equipment Mounting:
   1. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

C. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 07 72 00 "Roof Accessories" for installation of roof curbs.

D. Install units with clearances for service and maintenance of fans, motors and all other components that may need access

E. Label units according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 33 00 "Air Duct Accessories."

B. Install ducts adjacent to HVAC fans to allow service and maintenance.

C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
   5. Adjust belt tension.
   6. Adjust damper linkages for proper damper operation.
   7. Verify lubrication for bearings and other moving parts.
   8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
   9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
   10. Shut unit down and reconnect automatic temperature-control operators.
   11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and sawfeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.04 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 23 34 23

This page intentionally left blank

SECTION 23 35 16
HOSE REEL EQUIPMENT

PART 1 GENERAL

1.01 FURNISHED BY CONTRACTOR INSTALLED BY CONTRACTOR (FCIC)

A. Hose Reel Equipment shall be Furnished by Contractor, Installed by Contractor (FCIC)

1.02 SYSTEM DESCRIPTION

A. Equipment item is listed below by Equipment I.D. Tag.
   1. Wall Mounted Exhaust Hose Reel.
      a. Equipment I.D. Tag: MB-01 (Qty. 4)
   2. Diesel Cane Exhaust Adapter.
      a. Equipment I.D. Tag: MB-01a (Qty. 1)
   3. Wall/Stand Mounted Air Hose Reel.
      a. Equipment I.D. Tag: MB-02 (Qty. 5)
   4. Wall/Stand Mounted Oil Hose Reel.
      a. Equipment I.D. Tag: MB-06 (Qty. 8)

B. Hose Reel Equipment
   1. This section includes the specifications for Hose Reel Equipment that are being installed for the servicing of vehicles of various sizes and weights, as noted in the Bid Specifications and Bid Drawing Package.
      a. Hose Reel Equipment – Description of System(s)
         1) The configurations for Hose Reel are described below.
            (a) Standalone equipment for the servicing of vehicles on an assortment of Cars and Light / Heavy Duty Trucks.

C. Seismic Calculations
   1. For seismic calculations, Reference general seismic design criteria noted on Sheet S0.1 Division 1 – General, A.9.

D. List of Applicable Forms
   1. The General Conditions, Supplementary Conditions, Instructions to Bidders, Bid Form, all apply to these bid items.

1.03 DESCRIPTION OF WORK

A. List of Work
   1. The extent of the Work is shown on the drawings and is defined to include (but not by way of limitations) all labor, materials, freight, unloading, equipment, taxes, permits and supervision required for equipment and installation.

B. Coordination
   1. Contractor’s Responsibility: It will be the Contractor's responsibility to verify and establish a detailed installation schedule.
   2. Field Check: ALL BUILDING AND EQUIPMENT LAYOUT DIMENSIONS SHALL BE FIELD CHECKED AND VERIFIED BY CONTRACTOR PRIOR TO START OF INSTALLATION. NOTIFY THE CONSULTANT AND OWNER OF ANY DISCREPANCIES OR CONDITIONS AFFECTING MATERIALS AND/OR INSTALLATION WITHIN TEN (10) DAYS. IF A CONDITION EXISTS AND THE CONSULTANT OR OWNER IS NOT NOTIFIED THE ADDITIONAL COST TO CORRECT THE INSTALLATION IN ACCORDANCE WITH THE REQUIREMENTS OF THE OWNER WILL BE THAT OF THE CONTRACTOR.
   3. Delivery and Unloading: The Hose Reel Contractor shall be responsible for coordinating the delivery and unloading of the equipment to the job-site with the General Contractor to eliminate demurrage charges, unless authorized by the Owner or the Consultant. In order to eliminate disruption to the ongoing operations and prevent interference of dock access by trucks entering and leaving the site, temporary staging of materials will be provided outside of the building at a location designated by the Owner. The Hose Reel Contractor shall provide storage facilities (i.e. covers, closed containers) to protect equipment from

the elements (i.e. dust, dirt, rain, ice, snow, etc.) as necessary. Interior staging of equipment will be kept to a minimum so as not to disrupt ongoing operations.

1.04 QUALITY ASSURANCE

A. Standards
   1. Equipment Standards: The equipment covered by these Specifications shall be designed, assembled, tested and installed in accordance with the latest applicable standards, including:
      a. American National Standards Institute (ANSI).
      b. American Iron and Steel Institute.
         1) Specification for Design of Cold-Formed Steel Association - "Structural Members" 2015 edition.
      c. International Building Code (IBC)
         1) International Building Code including current Building Code Amendments. (2015 Edition)
      d. Seismic Zone
         1) The seismic zone for the project is Seismic Zone 3 with near source distance factors applied.
      e. Materials
         1) All materials furnished shall be new, free from defects, and UL-Approved where such approval is granted to the equipment to be furnished.
      f. Federal Inspection
         1) Latest published applicable Federal Specifications.
      g. OSHA
         1) Applicable OSHA Specifications.
      h. Building and Safety Codes
         1) Any applicable local building and safety codes pertaining to the Work.

B. Workmanship
   1. Trade Methods: Use the best trade methods throughout. Work evidencing substandard workmanship shall be corrected or replaced by the Contractor at the Contractor's expense, per the General Conditions.

C. Touch Up Paint: The method for the touch up of paint shall follow specifications section 3.02 Field Painting.

D. Guarantees
   1. WARRANTY:
      a. Warranty shall be the manufacturer's standard warranty and shall be specified by the Contractor in the contents of the proposal.
      b. The contractor shall provide an extended warranty for a period of three (3) years from Date of Acceptance.
      c. QUALITY OF MATERIALS AND EQUIPMENT: The Contractor guarantees the material and equipment delivered under the Contract to be free from defects in design or workmanship and against damages caused prior to final inspection. Unless otherwise specified, this guarantee extends for a period of three (3) years from the Date of Acceptance for both labor and materials.
      d. REPAIRING DEFECTS: The Contractor shall promptly repair or replace all defective or damaged items delivered under the Contract. The Hose Reel Contractor may elect to have any replaced item returned to his/her plant at his/her expense.

1.05 SUBMITTALS

A. Product Data: Submit latest edition of Hose Reel data sheet and outline drawing with the proposal.
   1. Shop Drawings:
      a. Shop Drawings, as stated in the General Conditions, shall include, but need not be limited to:
      b. Installation Plan: Proposed installation plan of equipment, including location and dimensions of new equipment clearly identified. It will be the Contractor's

responsibility to verify and establish a detailed installation schedule per the General Conditions.

c. Dimensions: Plan views showing all equipment dimensions along with any aisle clearance dimensions.
d. Bill of Materials: Bill of Materials per the General Conditions.
e. Approved Shop Drawings
f. It will be the Contractor's responsibility to obtain approved shop drawings signed by the Consultant and/or Owner per the General Conditions prior to fabrication.

2. Manufacturer's Reference:
   a. Prime Manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

      JohnDow EuroVent
      151 Snyder Ave.
      Barberton, OH 44203
      Phone: (800) 433-0708
      Website: https://www.euroventexhaust.com/
      Hose Reel Model: CAR-ALU-HD-6 BLUE w/adapters-6-VG
      Ventilation Fan: AF-12 w/reducer 6X7-RED and Motor Starter

      Ventaire
      11975 Portland Ave South Suite 104
      Burnsville, MN 55337
      Phone: (952) 894-6637
      Website: https://www.ventaire.com/
      Diesel Cane Adapter: DCA60

      REELCRAFT Industries, Inc.
      2842 E. Business Hwy. 30
      Columbia City, IN 46725
      Phone: (800) 444-3134
      Website: https://www.REELCRAFT.com/
      Low Pressure Air/Water Reels: 81100 OLP

      REELCRAFT Industries, Inc.
      2842 E. Business Hwy. 30
      Columbia City, IN 46725
      Phone: (800) 444-3134
      Website: https://www.REELCRAFT.com/
      Medium Pressure Oil Reels: 82075 OMP

      REELCRAFT Industries, Inc.
      2842 E. Business Hwy. 30
      Columbia City, IN 46725
      Phone: (800) 444-3134
      Website: https://www.skf/alemite.com/
      Odometer-Style Mechanical Meter: 33685-B

3. Other manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers may be considered as equal.

PART 2 PRODUCTS

2.01 HOSE REEL EQUIPMENT GENERAL

A. The Contractor shall provide the following:
   1. List of Required Items
      a. New Hose Reel as shown on the drawings, including freight, unloading, installation, touch-up painting, cleaning, and other equipment necessary to complete the system.

B. Quantity and Capacity
   1. See drawings for equipment location and configuration.

C. Standard Designs
   1. Components shall be of standard design and fabrication by the manufacturer so that all may be replaced or purchased at a future date without special charges or extended deliveries.
   2. The Bill of Materials for this Work is to be determined by the Contractor from the bid drawings and contents of the Specifications. Hose Reel Contractor to verify all information.

D. Codes
   1. The Hose Reel shall be designed and installed to the exact standards of the manufacturer and in all cases shall conform to applicable codes.

E. Loads and Capacity
   1. The Hose Reel shall be designed to handle specified loads.

F. Install
   1. The shipment of the Hose Reel shall include all components to allow immediate install upon receipt.

G. Anchoring
   1. All work must be rigid and anchored securely. Method of attachment to be approved prior to installation.

H. Touch Up
   1. The Hose Reel Contractor shall touch up any other Contractor's work damaged during the process per section 3.02 Field Painting.

2.02 HOSE REEL

A. General: Equipment Tag # MB-01 Hose Reel (Qty. 4)
   a. Description: Heavy Duty Hose Exhaust Reel typically used in commercial Vehicle Maintenance and Repair Shops.
   b. Physical Data:
   c. Overall Dimensions:
      1) Width: 38 3/4"
      2) Depth: 2'-5 3/16"
      3) Height: 23 5/8"
   d. Duct Size: 6"
   e. Duct length: 25'-0"
   2. Features and Construction:
      a. 2-year Manufacturer's warranty
   3. Finish: Manufactures Standard

B. General: Equipment Tag # MB-01 Exhaust Fan with SS hose Adapter (Qty. 4)
   1. Description: Heavy Duty Hose Exhaust Reel Fan typically used in commercial Vehicle Maintenance and Repair Shops.
   2. Physical Data:
      a. Overall Dimensions:
         1) Width: 17 1/4"
         2) Depth: 18 1/8"
         3) Height: 20"
      b. Inlet Duct Size: 6"
      c. Output Duct Size: 7"

d. Motor Size: .50 HP
e. Power Requirements: 460V, 1.1 FLA 60 Hz 3ph

3. Features and Construction:
   a. 2-year Manufacturer's warranty
4. Finish: Manufactures Standard

C. General: Equipment Tag # MB-01a Diesel Cane Adapter (Qty. 1)
1. Description: Heavy Duty Diesel Cane Adapter typically used in commercial Vehicle Maintenance and Repair Shops.
2. Physical Data:
   a. Overall Dimensions:
      1) Diameter: 6"
      2) Height: 8'-0"
3. Features and Construction:
   a. Integrated Stack Stop
   b. Wide Inlet hood, 20-gauge Aluminum
   c. Rigid Pipe: 26-gauge reinforced Aluminum
   d. Lifting Handles Qty. Two Minimum
   e. 2-year Manufacturer's warranty
4. Finish: Manufactures Standard

D. General: Equipment Tag # MB-05 Heavy-Duty Low-Pressure Spring Retractable Hose Reel (Compressed Air) (Qty. 5)

E. General: Equipment Tag # MB-05 Heavy-Duty Medium-Pressure Spring Retractable Hose Reel (Lubrication Fluids) (Qty. 8)
1. Description: Heavy Duty Retractable Hose Reel typically used in commercial Vehicle Maintenance and Repair Shops.
2. Physical Data:
   a. Overall Dimensions:
      1) Width: 10.5"
      2) Depth: 24"
      3) Height: 25 3/8"
3. Features and Construction:
   a. Hose Anti Latch-Out
   b. Guide Arm
   c. Structurally Reinforced Guide Arm and Pedestal Base
   d. Containerized Spring Assembly
   e. Dual Sealed Ball bearings
   f. 2-year Manufacturer's warranty
4. Finish: Manufactures Standard

F. General: Equipment Tag # MB-05a Odometer-Style Mechanical Meter (Lubrication Fluids) (Qty. 8)
1. Description: Odometer-Style Mechanical Meter typically used in commercial Vehicle Maintenance and Repair Shops.
2. Physical Data:
   a. Overall Dimensions:
      1) Weight: 5lbs.
3. Features and Construction:
   a. Large, easy to read dial face
   b. Ability to keep lifetime record of fluid dispensed
   c. Internal Filter Screen
   d. 1,000 psi (69 bar) max. operating pressure
   e. ½" NPT Inlet
   f. Compatibility – Oil, Gear Oil
   g. 2-year Manufacturer's warranty
4. Finish: Manufactures Standard

PART 3 EXECUTION

3.01 EXAMINATION

A. Coordination
   1. Each Contractor must give careful consideration to the ongoing facility operations and the work of other contractors during the entire project and shall organize his/her work so that it will not interfere with ongoing operations or interfere with or delay the work of others. Minimal disruption to ongoing operations is a priority. It is imperative that the schedule be maintained with any changes coordinated promptly with the General Contractor, Owner, and Consultant.

B. General Description
   1. The Hose Reel shall be installed true and properly aligned complete in all details and in accordance with the specifications, manufacturer's recommendations, and the drawings.

C. Installation Routine
   1. Installation shall include unloading, checking and security of equipment prior to erection, shimming, complete anchoring, touch up and cleaning. The Contractor shall provide storage facilities (i.e. covers, closed containers) to protect equipment from the elements (i.e. dust, dirt, rain, snow, etc.). Contractor shall use a transfer system to bring materials inside the building that is supplied by the Contractor. Contractor to ensure no damage to the overhead door, floor, facility or equipment.

D. Tools and Equipment
   1. The Contractor shall be responsible to provide all tools and equipment necessary for a complete and satisfactory installation. All wheeled and rolling equipment used in the building during construction (after slab on grade has been poured) must use wheel wraps as drip diapers or similar to protect floor from rubber marking and equipment spillage of oil or other substances.

E. Construction, lifts, man Lifts and Vehicles
   1. All wheeled and rolling equipment used in the building during construction (after slab on grade has been poured) must use wheel wraps as drip diapers or similar to protect floor from rubber marking and equipment spillage of oil or other substances.

F. Permits and Inspection
   1. Contractor shall obtain, and pay for, all necessary permit fees and inspections required by the State or local municipalities.

G. Damaged Materials
   1. Claims, due to freight damage, are the responsibility of Hose Reel Contractor. This includes any damage that is not evident at the time of the unloading of the equipment (i.e. concealed damage). Should such damage be uncovered, the Contractor must act promptly to repair/replace damaged equipment to minimize any delay to the schedule. Any added cost due to a delay is the responsibility of the Contractor.

H. Debris Disposal
   1. It shall be the responsibility of the Hose Reel Contractor to remove any debris resulting from his/her work on each and every workday to a pre-designated disposal area. This shall include all waste generated by the installer or any of his/her personnel, shipping containers, and/or construction materials. The Contractor shall broom clean the area each work day to leave the work area clean and allow the Owner access to scrub the floor. This will include organizing the materials not yet incorporated in the Work. At the completion of the work the Contractor shall remove all of his/her waste materials and rubbish from and about the project, as well as all his/her tools, construction equipment, machinery.

I. Clearance
   1. The Contractor shall be responsible for maintaining all clearances specified on the drawings.

J. Modifications
   1. The Contractor shall be responsible for the suitability of any Hose Reel component modifications required after installation begins. All modifications must be submitted and

approved by the Owner and Consultant prior to beginning Work. Modifications done by others must be approved by the Contractor prior to modification. The Contractor shall be responsible for such a modification by others.

K. Contractor's Survey of Damage
   1. The Contractor shall conduct a survey of his/her work each and every workday morning and note any and all damages observed. Any damages must be reported to the General Contractor and the Owner by 9:00 a.m. Damages not reported within this time frame will be the contractor's responsibility.

L. Marking Restrictions
   1. Under no circumstances will a magic marker, sharpie or any other permanent marking device, which will absorb into concrete, paint or decking, be used for marking equipment locations. All markings must be water soluble and removable. The contractor is responsible to remove these markings prior to completing the Punch List

M. Installation
   1. The Owner shall have the option of performing his/her own Hose Reel installation.

3.02 FIELD PAINTING

A. Cleaning
   1. All surfaces to be painted must be thoroughly cleansed of rust, scale, oil, grease, dirt, welding flash and all other forms of dirt detrimental to good painting practices.

B. Touch-Ups
   1. After the installations are complete, the Contractor shall touch-up any components that were damaged but only with owners/representative approval. Finish to match factory finish.

END OF SECTION 23 35 16

This page intentionally left blank

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Round ceiling diffusers.

B. Modular-core supply grille diffusers.

C. Adjustable blade face grilles.

D. Fixed face grilles.

1.02 RELATED REQUIREMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product.
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   2. Duct access panels.

B. Source quality-control reports.

PART 2 PRODUCTS

2.01 ROUND CEILING DIFFUSERS

A. Manufacturers:
   1. Titus TMRA .
   2. Krueger.
   3. Price Industries.

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel.

D. Finish: Baked enamel, white

E. Face Style: Three cone.

F. Mounting: Duct connection.

G. Pattern: Fully adjustable.

H. Accessories:
   1. Equalizing grid.
   2. Plaster ring.

3. Safety chain.
4. Wire guard.
5. Sectorizing baffles.
6. Operating rod extension.

2.02 MODULAR-CORE SUPPLY GRILLE DIFFUSERS

A. Manufacturers:
   1. Titus MCD.
   2. Krueger.
   3. Price Industries.

B. Material: Steel.

C. Face Style: Exposed modular core.

D. Discharge Pattern: Four-way.

E. Finish: White baked acrylic.

F. Border: 1-1/2-inch width with countersunk screw holes.

G. Blades:
   1. Airfoil, individually adjustable horizontally.
   2. Double deflection.
   3. Set in modules.

H. Modules: Removable; rotatable.

I. Mounting: Surface.

2.03 GRILLES

A. Manufacturers:
   1. Titus.
   2. Krueger.
   3. Price Industries.

B. Adjustable Blade Face Grille(SG-1):
   1. Material: Steel.
   2. Finish: Baked enamel, white.
   3. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
   4. Core Construction: Integral.
   5. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
   6. Frame: 1-1/4 inches wide.

C. Fixed Face Grille(EG-1, EG-2, RG-1, RG-2):
   1. Material: See schedule on drawings.
   2. Finish: Baked enamel, white.
   3. Face Arrangement: See schedule on drawings.
   4. Core Construction: Integral.
   5. Frame: 1-1/4 inches wide.
   6. Mounting Frame: See schedule on drawings.

2.04 ACCESSORIES

A. Flexible Duct Support
   1. Manufacturers: Titus FlexRight (no known equal)
      a. Radius forming brace to support 4-inch through 16-inch diameter flexible air ducts.
      b. Provide nylon cable ties to secure flex duct to FlexRight brace.

2.05 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install diffusers level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

D. Install Titus FlexRight brace at all flexible duct-to-diffuser connections.

3.03 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

This page intentionally left blank

SECTION 23 37 23
HVAC GRAVITY VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof hoods.

1.02 RELATED REQUIREMENTS

A. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

1.03 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.04 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.

1.05 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.

D. Stainless-Steel Sheet: ASTM A 666, Type 304, with No. 4 finish.

E. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
   1. Use types and sizes to suit unit installation conditions.
   2. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.02 FABRICATION, GENERAL

A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

E. Perform shop welding by AWS-certified procedures and personnel.

2.03 ROOF HOODS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation.
   2. Loren Cook Company.
   3. Twin City

B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 6-6 and 6-7.

C. Materials: Aluminum sheet, minimum 0.063-inch-thick base and 0.050-inch- thick hood; suitably reinforced.

D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch-thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
   1. Configuration: Self-flashing without a cant strip, with mounting flange.

E. Bird Screening: Stainless-steel, 1/2-inch- square mesh, 0.047-inch wire.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.

B. Install gravity ventilators with clearances for service and maintenance.

C. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 07 92 00 "Joint Sealants" for sealants applied during installation.

E. Label gravity ventilators according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

G. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.02 CONNECTIONS

A. Duct installation and connection requirements are specified in Section 23 31 13 "Metal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

3.03 ADJUSTING

A. Adjust damper linkages for proper damper operation.

END OF SECTION 23 37 23

SECTION 23 64 33

AIR HEATED MODULAR WATER HEATER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air to Water Heat Pump Boiler.

1.02 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.03 DEFINITIONS

A. BAS: Building automation system.

B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

C. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.

D. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by AHRI 550/590 and referenced to AHRI standard rating conditions.

E. kW/Ton: The ratio of total power input of the heater in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.

F. NPLV: Nonstandard part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by AHRI 550/590 and intended for operating conditions other than AHRI standard rating conditions.

1.04 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Scroll water heaters shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
   1. The term "withstand" means, "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

1.05 ACTION SUBMITTALS

A. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.
   1. Performance at AHRI standard conditions and at conditions indicated on Drawings.
   2. Performance at AHRI standard unloading conditions.
   3. Minimum evaporator flow rate.
   4. Refrigerant capacity.
   5. Oil capacity of water heater.
   6. Fluid capacity of evaporator.
   7. Fluid capacity of condenser.
   8. Characteristics of safety relief valves.
   9. Minimum entering condenser-air temperature.

B. Shop Drawings: Complete set of manufacturer's prints of water heater assemblies, control panels, sections and elevations, and unit isolation. Include the following:
   1. Assembled unit dimensions.
   2. Weight and load distribution.
   3. Required clearances for maintenance and operation.
   4. Size and location of piping and wiring connections.
   5. Wiring Diagrams: For power, signal, and control wiring.

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Structural supports.
   2. Piping roughing-in requirements.
   3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
   4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

B. Certificates: For certification required in “Quality Assurance” Specification.

C. Seismic Qualification Certificates: For water heaters, accessories, and components from manufacturers.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source Quality Control Test Reports: Provide.

E. Startup Service Reports: Provide.

F. Warranty: Sample of special warranty.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each water heater to include in emergency, operation, and maintenance manuals.

1.08 QUALITY ASSURANCE

A. AHRI Certification: Certify heater according to AHRI 590 certification program.

B. AHRI Rating: Rate water heater performance according to requirements in AHRI 550/590, “Water Chilling Packages Using the Vapor Compression Cycle.”

C. ASHRAE Compliance: ASHRAE 15 for safety code for mechanical refrigeration.

D. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - “Heating, Ventilating, and Air-Conditioning.”

E. ASME Compliance: Fabricate and stamp water heater heat exchangers to comply with ASME Boiler and Pressure Vessel Code.

F. NFPA 70: Comply with NFPA 70.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Shipping: Ship water heaters from the factory fully charged with refrigerant and filled with oil.

1.10 COORDINATION

A. Structural Attachments: Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

B. Equipment Mounted on Roof: Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.11 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of water heaters that fails in materials or workmanship within specified period.
   1. Compressor Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 AIR TO WATER HEAT PUMP BOILER (HPB-1X)

A. Manufacturers:
   1. AERMEC.
   2. AIRSTACK.
   3. Jetson.

B. System Description: Outdoor air-to-water heat pump boiler capable of providing central heating hot water. Heater shall incorporate Scroll type compressors and can consist of multiple modules. There are two heat pumps, each with three compressors. This is to provide a total heating plant with six stages and a turn down to 1/6. Each refrigerant circuit shall consist of a tandem compressor set, crankcase heater, evaporator, refrigerant to hot water heat exchanger, air to refrigerant heat exchanger, electronic expansion valves, liquid line solenoid valves, filter driers, and control system. Each circuit shall be constructed to be independent of other circuits from a refrigeration and electrical stand-point. The multi-module unit must be able to produce hot water even in the event of a failure of one or more refrigerant circuits. Controls shall include a head pressure/suction pressure controlled, variable flow defrost cycle. The heat pumps have dedicated pumps.

C. General:
   1. Modules shall be ETL listed in accordance with UL Standard 1995, CSA certified per Standard C22.2#23. Modules shall ship wired and charged with refrigerant. All modules shall be factory run tested prior to shipment on an AHRI certified or 3rd party verified test stand.
   2. Compressors, heat exchangers, condenser fans, piping and controls shall be mounted on a heavy gauge galvanized steel frame with 3 mil powder coat paint. Electrical controls, contactors, and relays for each module shall be mounted within that module. Module shall be provided within a steel enclosure suitable for outdoor use. Exposed steel surfaces shall be provided with 3 mil powder coat paint. Module must have base with cutouts for forklift or pallet jack.

D. Pumps and Piping:
   1. Pumps: each heat pump has a dedicated pump, sized for the flow by the manufacturer, and wired/controlled directly by the heat pump. Refer to Section 23 21 23 Hydronic Pumps for specifications.
   2. Hot Water Mains: Each module shall include supply and return mains for hot water. Cut grooved end connections are provided for interconnection to four six inch standard piping with grooved type couplings. Rolled grooved shall be unacceptable.

E. Heat Exchangers:
   1. Evaporator: Each evaporator shall be a brazed plate heat exchanger constructed of 316 stainless steel; designed, tested, and stamped in accordance with UL 1995 code for 650 psig working pressure. The evaporator heat exchanger shall not be mounted above the compressor, to eliminate the effect of migration of refrigerant to the cold evaporator with consequent liquid slugging on start-up.
   2. Condenser: Each condenser shall be a brazed plate heat exchanger constructed of 316 stainless steel; designed, tested, and stamped in accordance with UL 1995 code for 650 psig working pressure.
   3. Air side heated coil shall have aluminum fins mechanically bonded to copper tubes and be factory leak tested.

F. Compressor: Each module shall contain two hermetic scroll compressors in a tandem piping arrangement mounted to the module with rubber-in-shear isolators. Each system also includes high discharge pressure and low suction pressure safety cut-outs.

G. Source Fans: Each module shall contain dual fans for each refrigerant circuit. Module shall utilize ECM. Blades are aluminum construction owlet design 7-blade axial fan with integral EC motor (direct drives with external VFD driven motors are not acceptable). Efficiency exceeds

criteria set out in the ErP 2015 directive. Individual fans are factory tested. Encapsulation required. Encapsulation is a process of filling a complete electronic assembly with a solid compound for resistance to shock and vibration, and for exclusion of moisture and corrosive agents. Sound pressure reductions at 30 feet, as compared to standard fan option, ranges from 3-6 dBA.

H. Central Control System:
   1. Scheduling of the various compressors shall be performed by a microprocessor based control system. A new lead compressor is selected every 24 hours to assure even distribution of compressor run time.
   2. The Master Controller shall monitor and report the following on each refrigeration system:
      a. Discharge Pressure Fault.
      b. Suction Pressure Fault.
      c. Compressor Winding Temperature.
      d. Refrigerant Temperature.
      e. Water Entering and Leaving Temperature.
      f. Proof of Water Flow.
   3. An out of tolerance indication from these controls or sensors shall cause a “fault” indication at the Master Controller and shutdown of that compressor with the transfer of load requirements to the next available compressor. In the case of a System Fault the entire unit will be shut down. When a fault occurs, the Master Controller shall record conditions at the time of the fault and store the data for recall. This information shall be capable of being recalled through the keypad of the Master Controller and displayed on the Master Controller’s 2 line by 40 character back-lit LCD. A history of faults shall be maintained including date and time of day of each fault (up to the last 20 occurrences).
   4. Individual monitoring of leaving water temperatures from each refrigeration system shall be programmed to protect against freeze-up. Individual monitoring of leaving hot water temperatures from each refrigeration system shall be programmed to protect against hi head pressure conditions.
   5. Operation:
      a. The control system shall monitor water temperatures to determine hot water system demand. The control system will use the demand to make staging mode decisions and select the number of compressor circuits required to operate. Mode decisions shall be available from the controller as well as via remote input. Response times and set points shall be adjustable. The system shall provide for variable time between compressor sequencing and temperature sensing, so as to optimize the performance to different existing building loads.
   6. Interoperability:
      a. The unit shall interface to the building automation system. Interface shall be accomplished using communication over BACNet.

I. Unit shall have external inputs and outputs to be compatible with the building management system to include Remote Start/Stop capability and Alarm output.

J. Single Point Power Connection:
   1. Unit shall be provided with a single point power connection at a 5,000 amp SCCR. This will include pre-engineered wiring for field installation and connection to a factory mounted junction box. Junction box shall include branch circuit protection for each module and provide a single point of connection to building power. This includes the dedicated hydronic pump.

K. LIFTING FRAME
   1. Painted steel frame will be provided with all modules mounted upon it. Typically, all water and wiring connections will be made between the modules at the factory.

2.02 SAFETIES, CONTROLS AND OPERATION

A. The unit safety controls shall be provided (minimum) as follows:

1. Low evaporator refrigerant pressure.
2. Loss of water flow.
3. High condenser refrigerant pressure.
4. High compressor motor temperature.
5. Low suction gas temperature.
6. Low leaving evaporator water temperature.

B. The heat pump shall be provided with internal heat tracing and insulation on water piping and water side heat exchangers. This shall provide freeze protection when the unit is exposed to freezing temperatures and not in operation. See specification Section 23 07 19 HVAC Piping Insulation for heat trace. Provide a dedicated 120-volt electrical connection.

C. Failure of unit to start or shutdown due to any of the above safety cutouts shall be annunciated by display of the appropriate diagnostic description at the unit control panel. This annunciation will be in plain English. Alphanumeric codes shall be unacceptable.

D. The unit shall be furnished with a Master Controller as an integral portion of the control circuitry to provide the following functions:
1. Provide automatic shutdown during periods when the load level decreases below the normal operating requirements. Upon an increase in load, the unit shall automatically restart.
2. Provisions for connection to automatically enable the unit from a remote energy management system.
3. The control panel shall provide alphanumeric display showing all system parameters in the English language with numeric data in English units.

E. Normal Operation
1. When unit is enabled, the factory supplied controller modulates the capacity from minimum to maximum as required by building load.
2. The control system shall respond to Entering Water Temperature and will have an integral reset based on entering water temperature to provide for efficient operation at part-load conditions.

PART 3 EXECUTION

3.01 EXAMINATION

A. General: Before water heater installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting water heater performance, maintenance, and operations.
1. Water heater locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Corrections: Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 WATER HEATER INSTALLATION

A. Heater Support: Install water heaters on support structure indicated.

B. Equipment Mounting: Install water heater using restrained spring isolators. Comply with requirements for vibration isolation devices specified in Section 23 05 48 “Vibration and Seismic Controls for HVAC Piping and Equipment.”
1. Minimum Deflection: 1.00 inch.

C. Refrigerant Charge and Oil Fill: Charge water heater with refrigerant if not factory charged and fill with oil if not factory installed.

D. Devices Shipped Loose: Install separate devices furnished by manufacturer and not factory installed.

3.03 CONNECTIONS

A. Hydronic Piping: Comply with requirements in Section 23 21 13 “Hydronic Piping.” Drawings indicate general arrangement of piping, fittings, and specialties.

B. Service and Maintenance: Install piping adjacent to heater to allow service and maintenance.

C. Drain: Connect each drain connection with a union and drain pipe and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection if required.

D. Flow Switches: Provide and wire water flow switches per manufacturer's requirements. Locate switches between heater and isolation valves.

E. Air Vent Locations: Where not specifically indicated, provide automatic air vents at high point(s) of system.

3.04 STARTUP SERVICE

A. Startup Service: Engage a factory-authorized service representative to perform startup service.

B. Final Inspection: Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Startup: Complete installation and startup checks according to manufacturer's written instructions and perform the following:
   1. Verify that refrigerant charge is sufficient and water heater has been leak tested.
   2. Verify that pumps are installed and functional.
   3. Verify that thermometers and gauges are installed.
   4. Operate water heater for run-in period.
   5. Check bearing lubrication and oil levels.
   6. Verify that refrigerant pressure relief device for heaters installed indoors are vented outside.
   7. Verify proper motor rotation.
   8. Verify static deflection of vibration isolators, including deflection during water heater startup and shutdown.
   9. Verify and record performance of water heater protection devices.
   10. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

D. Startup Report: Prepare a written startup report that records results of tests and inspections.

3.05 DEMONSTRATION

A. Training: Engage a factory-authorized service representative to train Contracting Agency's maintenance personnel to adjust, operate, and maintain water heaters. Video record the training sessions.

END OF SECTION 23 64 33

SECTION 23 74 33
DEDICATED OUTDOOR-AIR UNITS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes factory-packaged units capable of supplying up to 100 percent outdoor air and providing cooling and heating.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

C. Delegated-Design Submittal: For design of vibration isolation, seismic restraints and wind restraints, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof-curb mounting details, drawn to scale, and coordinated with each other, using input from installers of the items involved:

B. Seismic Qualification Certificates: For dedicated outdoor-air units, accessories, and components, from manufacturer.

C. Startup service reports.

D. Sample warranty.

1.04 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.05 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Five years from date of Substantial Completion.
   2. Warranty Period for Heat Exchangers: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aaon.

B. Ventacity

C. Desert Aire.

D. Trane.

E. Innovent.

F. Daiken.

2.02 PERFORMANCE REQUIREMENTS

A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design vibration isolation, seismic restraints and wind restraints.

C. Seismic Performance: Units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

D. Wind-Restraint Performance:
   1. Building Classification Category: II.
   2. Minimum 10 lb/sq. ft multiplied by the maximum area of unit projected on a vertical plane that is normal to the wind direction and 45 degrees either side of normal.

E. Cabinet Thermal Performance:
   1. Maximum Overall U-Value: Comply with requirements in ASHRAE/IESNA 90.1.
   2. Include effects of metal-to-metal contact and thermal bridges in the calculations.

F. Cabinet Surface Condensation:
   1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
   2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.

G. Maximum Cabinet Leakage: SMACNA leakage class rating of 5.0.

H. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.03 CABINET

A. Construction: double wall.

B. Exterior Casing Material: Galvanized steel with paint finish.

C. Interior Casing Material: Galvanized steel.

D. Lifting and Handling Provisions: Factory-installed shipping skids and lifting lugs.

E. Base Rails: Galvanized-steel rails for mounting on roof curb or pad as indicated.

F. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
   1. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.

G. Roof: Standing seam or membrane; sloped to drain water.

H. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.

I. Cabinet Insulation:
   1. Type: rigid polyurethane foam.
   2. Thickness: 2 inches.
   3. Insulation Adhesive: Comply with ASTM C916, Type I.
   4. Mechanical Fasteners: Suitable for adhesive, mechanical, or welding attachment to casing without damaging liner and without causing air leakage when applied as recommended by manufacturer.

J. Condensate Drain Pans:
   1. Shape: Rectangular, with 1 percent slope in at least two planes to direct water toward drain connection.
   2. Size: Large enough to collect condensate from cooling coils including coil piping connections, coil headers, and return bends.
      a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
      b. Depth: A minimum of 2 inches deep.
   3. Configuration: Single wall.
   4. Configuration: Double wall, with space between walls filled with foam insulation and moisture-tight seal.
   5. Material: Galvanized-steel sheet with asphaltic waterproofing compound coating on pan top surface.
   6. Material: Stainless-steel sheet.

7. Drain Connection:
    a. Located on one end of pan, at lowest point of pan.
    b. Terminated with threaded nipple.
    c. Minimum Connection Size: NPS 1.
8. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

K. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1 for resistance to mold and erosion.

L. Roof Custom Seismic Curb: Full-perimeter curb of sheet metal, minimum 24 inches high, with wood nailer, neoprene sealing strip, and welded Z-bar flashing.
1. Comply with requirements in "The NRCA Roofing Manual."
2. Provide Seismic certification of roof curb.

2.04 SUPPLY FAN

A. Plenum Fan Type: Single width, non-overloading, with backward-inclined or airfoil blades.
1. Fan Wheel Material: Aluminum; attached directly to motor shaft.
2. Fan Wheel Drive and Arrangement: Direct drive, AMCA Arrangement 4.
3. Fan panel and frame Material: Powder-coated steel, stainless steel, or aluminum.
4. Fan Enclosure: Easily removable enclosure around rotating parts.
5. Fan Balance: Precision balance fan below 0.08 inch/s at design speed with filter in.

B. Motors:
1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
2. Enclosure: Totally enclosed.
3. Enclosure Materials: Cast iron.
4. Efficiency: Premium efficient.
5. NEMA Design: Premium efficiency.
6. Service Factor: 1.15.

C. Mounting: Fan wheel, motor, and drives shall be mounted to fan casing with restrained spring isolators.

2.05 COOLING COILS (HRV-1 AND 6)

A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410.

B. Coil Casing Material: Aluminum.

C. Tube Material: Copper.

D. Tube Header Material: Copper.

E. Fin Material: Aluminum.

F. Fin and Tube Joints: Mechanical bond.

G. Leak Test: Coils shall be leak tested with air underwater.

H. Refrigerant Coil Capacity Reduction: Circuit coils for interleaved control.

I. Refrigerant Coil Suction and Distributor Header Materials: Seamless copper tube with brazed joints.

J. Coating: Corrosion-resistant coating after assembly.

2.06 REFRIGERATION SYSTEM (HRV-1 AND 6)

A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."

B. Refrigerant Charge: Factory charged with refrigerant and filled with oil.

C. Compressors: Scroll compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief.

D. Refrigerant: R-410A.
   1. Classified as Safety Group A1 according to ASHRAE 34.
   2. Provide unit with operating charge of refrigerant.

E. Refrigeration System Specialties:
   1. Expansion valve with replaceable thermostatic element.
   2. Refrigerant dryer.
   3. High-pressure switch.
   4. Low-pressure switch.
   5. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
   6. Brass service valves installed in discharge and liquid lines.

F. Capacity Control:
   1. Hot-gas bypass refrigerant control for capacity control with continuous dehumidification on a single compressor.
   2. Patented, Rawal APR control with zero to 100 percent modulating capacity control using hot-gas bypass. Evaporator coil shall be continuously active for dehumidification.
   3. Single compressor with evaporator and condenser coil within the refrigerant section to provide initial pre-cooling and to reheat for humidity control.
   4. Heat-pipe heat exchanger wrapped around the evaporator coil to pre-cool the air entering the evaporator coil and reheat the air leaving the evaporator coil to control humidity.

G. Refrigerant condenser coils:
   1. Capacity Ratings: Complying with ASHRAE 33 and ARI 410.
   2. Tube Material: Copper.
   3. Fin Material: Aluminum.
   4. Fin and Tube Joint: Mechanical bond.
   5. Leak Test: Coils shall be leak tested with air underwater.
   6. Coating: Corrosion-resistant coating after assembly.

H. Condenser Fan Assembly:
   1. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades.
   2. Fan Motors:
      a. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
      b. Motor Enclosure: Totally enclosed non-ventilating (TENV) or totally enclosed air over (TEAO) enclosure.
      c. Enclosure Materials: Cast iron.
      d. Motor Bearings: Permanently lubricated bearings
      e. Built-in overcurrent and thermal-overload protection.
      f. Efficiency: Premium efficient.
      g. NEMA Design: Premium efficiency
      h. Service Factor:1.15.
   3. Fan Safety Guards: Steel with corrosion-resistant coating.

I. Safety Controls:
   1. Compressor motor and condenser coil fan motor low ambient lockout.
   2. Overcurrent protection for compressor motor.

2.07 ELECTRIC-RESISTANCE HEATING COIL (HRV-1 AND 6)

A. UL Compliance: Comply with requirements in UL 1995, "Heating and Cooling Equipment."

B. Electric-Resistance Heating Elements:
   1. Coiled Resistance Wire: 80 percent nickel and 20 percent chromium.
   2. Tubular-Steel Sheath: Compacted magnesium oxide powder.
   3. Fins: Spiral-wound, copper-plated, steel fins continuously brazed to sheath.

4. Heating Capacity: Low density 35 W per sq. in., factory wired for single-point wiring connection; with time delay for element staging and overcurrent- and overheat-protection devices.
5. Safety Controls:
   a. Blower-motor interlock, air-pressure switch.
   b. Quiet mercury contactors.
   c. Time delay between steps.
   d. Integral, nonfused power disconnect switch.

C. Electric-Resistance Heating Elements:
1. Open-Coil Resistance Wire: 80 percent nickel and 20 percent chromium.
2. Supports and Insulation: Floating ceramic bushings recessed into casing openings; fastened to supporting brackets and mounted in galvanized-steel frame.
3. Heating Capacity: Low density 35 W per sq. in., factory wired for single-point wiring connection; with time delay for element staging and overcurrent- and overheat-protection devices.
4. Safety Controls:
   a. Blower-motor interlock, air-pressure switch.
   b. Quiet mercury contactors.
   c. Time delay between steps.
   d. Integral, nonfused power disconnect switch.

2.08 OUTDOOR-AIR INTAKE HOOD

A. Type: Manufacturer's standard hood or louver.

B. Materials: Match cabinet.

C. Bird Screen: Comply with requirements in ASHRAE 62.1.

D. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.09 FILTERS

A. Disposable Panel Filters:
1. Comply with NFPA 90A.
2. Factory-fabricated, viscous-coated, flat-panel type.
3. Thickness: See schedule on drawings.
4. Initial Resistance: See schedule on drawings.
5. Recommended Final Resistance: See schedule on drawings.
6. Minimum MERV: according to ASHRAE 52.2. See schedule on drawings.
7. Media: Interlaced glass fibers sprayed with nonflammable adhesive.

B. Extended-Surface, Disposable Panel Filters:
1. Comply with NFPA 90A.
2. Factory-fabricated, dry, extended-surface type.
3. Thickness: See schedule on drawings.
4. Initial Resistance: See schedule on drawings.
5. Recommended Final Resistance: See schedule on drawings.
6. Minimum MERV: according to ASHRAE 52.2. See schedule on drawings.
7. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.

2.10 HEAT AND ENERGY RECOVERY EXCHANGER

A. ALUMINUM sensible HEAT RECOVERY wheel (HRU-1 AND 6):
1. Integral purge section limiting carryover of exhaust air to 1%.
2. segmented wheel strengthened with radial spokes impregnated with non-migrating, water-selective, molecular-sieve desiccant coating.
3. Fractional horsepower motor and gear reducer , with speed changed by variable frequency controller and self-adjusting multilink belt around outside of rotor.
4. Aluminum frame; stainless steel drain pan.

5. Outside air bypass.
6. Aluminum Plate Heat Recovery Exchangers (HRU-2, 3, 4 and 5):
7. Aluminum, sensible, parallel counter flow, flat plate, heat exchanger.
8. Smooth aluminum plates separated by formed ribs; aluminum frame; stainless steel drain pan.
9. Outside air bypass.

2.11 ELECTRICAL POWER CONNECTIONS

A. General Electrical Power Connection Requirements: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.

B. Enclosure: NEMA 250, Type 4X, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key,

C. Wiring: Numbered and color-coded to match wiring diagram.

D. Wiring Location: Install factory wiring outside an enclosure in a raceway.

E. Power Interface: Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.

F. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:
   1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
   2. NEMA KS 1, heavy-duty, nonfusible switch.
   3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

G. Factory-Mounted, Overcurrent-Protection Service: For each motor.

H. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

I. Controls: Factory wire unit-mounted controls where indicated.

J. Lights: Factory wire unit-mounted lights.

K. Receptacle: Factory wire unit-mounted, ground fault interrupt (GFI) duplex receptacle.

L. Control Relays: Auxiliary and adjustable time-delay relays.

2.12 CONTROLS

A. Control equipment and sequence of operation are specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC" and Section 23 09 93.11 "Sequence of Operations for HVAC DDC."

B. Control Valves: Comply with requirements in Section 23 09 23.11 "Control Valves."

C. Control Wiring: Factory wire connection for controls' power supply.

D. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.

E. Control Dampers:
   1. Damper Location: Factory installed inside unit for ease of blade axle and bushing service. Arrange dampers located in a mixing box to achieve convergent airflow to minimize stratification.
   2. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. at a static-pressure differential of 4.0 inches water column when a torque of 5 in./lb per sq. ft. is applied to the damper jackshaft.
   3. Damper Rating: Rated for close-off pressure equal to the fan shutoff pressure.
   4. Damper Label: Bear the AMCA seal for both air leakage and performance.

5. Blade Configuration: Unless otherwise indicated, use parallel blade configuration for two-position control and equipment isolation service and use modulating control when mixing two airstreams. For other applications, use an opposed-blade configuration.
6. Damper Frame Material: Extruded aluminum, galvanized steel or stainless steel.
7. Blade Type: hollow-shaped airfoil.
8. Blade Material: Extruded aluminum.
9. Maximum Blade Width: 6 inches.
10. Maximum Blade Length: 48 inches.
11. Blade Seals: Replaceable, continuous perimeter vinyl seals and jambs with stainless-steel compression-type seals.
12. Bearings: Thrust bearings for vertical blade axles.
13. Airflow Measurement (HRV-1 and 6):
    a. Monitoring System: Complete and functioning system of airflow monitoring as an integral part of the damper assembly where indicated.
    b. Remote Monitoring Signal: 0-10 volt or 4-20 mA scaled signal.
    c. Accuracy of flow measurement: Within 5 percent of the actual flow rate between the range of the scheduled minimum and maximum airflow. For units with a large range between minimum and maximum airflow, configure the damper sections and flow measurement assembly as necessary to comply with accuracy.
    d. Straightening Device: Integral to the flow measurement assembly if required to achieve the specified accuracy as installed.
    e. Flow measuring device: Suitable for operation in untreated and unfiltered outdoor air. If necessary, include temperature and altitude compensation and correction to maintain the accuracy.

F. Damper Operators:
1. Factory-installed electric operator for each damper assembly with one operator for each damper assembly mounted to the damper frame.
2. Operator capable of shutoff against fan pressure and able to operate the damper with sufficient reserve power to achieve smooth modulating action and proper speed of response at the velocity and pressure conditions to which the damper is subjected.
3. Maximum Operating Time: Open or close damper 90 degrees in 60 seconds.
4. Adjustable Stops: For both maximum and minimum positions.
5. Position Indicator and Graduated Scale: Factory installed on each actuator with words "OPEN" and "CLOSED," or similar identification, at travel limits.
6. Spring-return operator to fail-safe; either closed or open as required by application.
7. Operator Type: Direct coupled, designed for minimum 60,000 full-stroke cycles at rated torque.
8. Position feedback Signal: For remote monitoring of damper position.
9. Coupling: V-bolt and V-shaped, toothed cradle.
10. Circuitry: Electronic overload or digital rotation-sensing circuitry.

G. Electric-Resistance Heat Controls:
1. Remote sensor for field installation in supply-air duct with sensor adjustment located in control panel to control electric coil to maintain temperature.
2. Capacity Controls: Modulating.

H. Damper Controls: See control sequence on drawings.

I. Integral Smoke Alarm: Smoke detector installed in supply air.

J. DDC Temperature Control: Standalone control module for link between unit controls and DDC temperature-control system. Control module shall be compatible with control system specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC." Links shall include the following:
1. Start/stop interface relay, and relay to notify DDC temperature-control system alarm condition.
2. Hardware interface or additional sensors for the following:
    a. Discharge-air temperature.

b. Refrigeration system operating.
c. Furnace operating.
d. Constant and variable motor loads.
e. Variable-frequency-controller operation.
f. Cooling load.
g. Economizer cycles.
h. Air-distribution static pressure and ventilation-air volumes.

K. Interface with DDC System for HVAC: Factory-installed hardware and software to enable the DDC system for HVAC to monitor, control, and display unit status and alarms.
1. Hardwired Points:
a. Monitoring: On-off status, common trouble alarm.
b. Control: On-off operation, supply temperature set-point adjustment, space pressure set-point adjustment.
2. ASHRAE 135 (BACnet) communication interface with the DDC system for HVAC shall enable the DDC system for HVAC operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the DDC system for HVAC.

2.13 ACCESSORIES

A. Service Lights and Switch: Factory installed in each accessible section with weatherproof cover. Factory wire lights to a single-point field connection.

B. Duplex Receptacle: Factory mounted in unit supply-fan section and refrigeration section, with 20 amp 120 V GFI duplex receptacle and weatherproof cover.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.

B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."
1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 07 72 00 "Roof Accessories."
3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.

C. Restrained Curb Support: Install restrained vibration isolation roof-curb rails on roof structure according to "The NRCA Roofing Manual."

D. Equipment Mounting:
1. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
2. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."

E. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

F. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.

G. Install separate devices furnished by manufacturer and not factory installed.

H. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

I. Install drain pipes from unit drain pans to sanitary drain.
1. Drain Piping: Schedule 40 PVC pipe complying with ASTM D1785, with solvent-welded fittings.

2. Pipe Size: Same size as condensate drain pan connection.

3.02 CONNECTIONS

A. Where installing piping adjacent to units, allow space for service and maintenance.

B. Duct Connections:
   1. Comply with requirements in Section 23 31 13 "Metal Ducts."
   2. Drawings indicate the general arrangement of ducts.
   3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 23 33 00 "Air Duct Accessories."

C. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.
   1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.03 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
      a. High-limit heat exchanger.
      b. Alarms.
   3. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
   4. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:
      a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
      b. Cooling coil entering-air, dry- and wet-bulb temperatures.
      c. Condenser coil entering-air dry-bulb temperature.
      d. Condenser coil leaving-air dry-bulb temperature.
   5. Simulate maximum cooling demand and inspect the following:
      a. Compressor refrigerant suction and hot-gas pressures.
      b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
   6. Inspect casing insulation for integrity, moisture content, and adhesion.
   7. Verify that clearances have been provided for servicing.
   8. Verify that controls are connected and operable.
   9. Verify that filters are installed.
   10. Clean coils and inspect for construction debris.
   11. Inspect and adjust vibration isolators and seismic restraints.
   12. Verify bearing lubrication.
   13. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
   14. Adjust fan belts to proper alignment and tension.
   15. Start unit.
   16. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
   17. Operate unit for run-in period.
   18. Calibrate controls.
   19. Adjust and inspect high-temperature limits.
   20. Inspect outdoor-air dampers for proper stroke.
   21. Verify operational sequence of controls.
   22. Measure and record the following airflows. Plot fan volumes on fan curve.
      a. Supply-air volume.
      b. Return-air flow.
      c. Outdoor-air flow.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.

D. Prepare written report of the results of startup services.

3.04 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 23 74 33

SECTION 23 81 26

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.02 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.03 ACTION SUBMITTALS

A. Submittals shall be formatted per Section 23 00 00 “General Mechanical Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
   1. “No Exception Taken”.
   2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

C. LEED Submittals:
   1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.

D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

E. Samples for Initial Selection: For units with factory-applied color finishes.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

~~B.~~ Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

B. Warranty

C. Start-up reports

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: One extra set for each air-handling unit.
   2. Fan Belts: One extra set for each air-handling unit fan.

1.07 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:
   1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
   2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.08 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period:
      a. For Compressor: Five year(s) from date of Substantial Completion.
      b. For Parts: One year(s) from date of Substantial Completion.
      c. For Labor: One year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Trane
   2. Carrier
   3. Daikin
   4. Mitsubishi

2.02 INDOOR UNITS

A. Concealed Evaporator-Fan Components:
   1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
   2. Insulation: Faced, glass-fiber duct liner.
   3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
   4. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
   5. Fan Motors:
      a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
      b. ECM, or multispeed with internal thermal protection and permanent lubrication.
      c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
   6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
   7. Condensate Drain Pans:
      a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
2) Depth: A minimum of 2 inches deep.

b. Single-wall, stainless-steel sheet.
c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
1) Minimum Connection Size: NPS 3/4

B. Floor-Mounted, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.
a. Discharge Grille: Steel with surface-mounted frame.
b. Insulation: Faced, glass-fiber duct liner.
c. Drain Pans: Galvanized steel, with connection for drain; insulated.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Fan: Direct drive, centrifugal
4. Fan Motors:
a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
5. Air Filtration Section:
a. General Requirements for Air Filtration Section:
1) Comply with NFPA 90A.
2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
b. Disposable Panel Filters:
1) Factory-fabricated, viscous-coated, flat-panel type.
2) Thickness: 2 inches. (
3) Arrestance according to ASHRAE 52.1: 80
4) MERV according to ASHRAE 52.2: 13
5) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.

C. Wall-Mounted, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Fan: Direct drive, centrifugal.
4. Fan Motors:
a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
b. ECM or Multitapped, multispeed with internal thermal protection and permanent lubrication.
c. Enclosure Type: Totally enclosed, fan cooled.
d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

f. Mount unit-mounted disconnect switches on exterior of unit.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Condensate Drain Pans:
   a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
      2) Depth: A minimum of 1 inch deep.
   b. Single-wall, stainless-steel sheet.
   c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
      1) Minimum Connection Size: NPS 3/4
7. Air Filtration Section:
   a. General Requirements for Air Filtration Section:
      1) Comply with NFPA 90A.
      2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
      3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
   b. Disposable Panel Filters:
      1) Factory-fabricated, viscous-coated, flat-panel type.
      2) Thickness: 2 inches.
      3) Arrestance according to ASHRAE 52.1: 80
      4) MERV according to ASHRAE 52.2: 13
      5) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.

2.03 OUTDOOR UNITS

A. Air-Cooled, Compressor-Condenser Components:
   1. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
   2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
      a. Compressor Type: Scroll.
      b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
      c. Refrigerant Charge: R-410A
      d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
   3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
   4. Fan: Aluminum-propeller type, directly connected to motor.
   5. Motor: Permanently lubricated, with integral thermal-overload protection.
   6. Low Ambient Kit: Permits operation down to 45 deg F.
   7. Mounting Base: Polyethylene.

2.04 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC" and Section 23 09 93.11 "Sequence of Operations for HVAC DDC."

B. Thermostat: Low voltage with subbase to control compressor and evaporator fan. Thermostat: (Wireless infrared functioning) to remotely control compressor and evaporator fan, with the following features:
   1. Compressor time delay.
   2. 24-hour time control of system stop and start.
   3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
   4. Fan-speed selection including auto setting.

D. Automatic-reset timer to prevent rapid cycling of compressor.

E. Refrigerant Line Kits: Type ACR, Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

F. Drain Hose: For condensate.

G. Additional Monitoring:
   1. Monitor constant and variable motor loads.
   2. Monitor variable-frequency-drive operation.
   3. Monitor economizer cycle.
   4. Monitor cooling load.
   5. Monitor air distribution static pressure and ventilation air volumes.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure as detailed on the drawings.

C. Install roof-mounted, compressor-condenser components on equipment supports as detailed on the drawings.

D. Equipment Mounting:
   1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
   2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
   3. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
   4. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."

E. Install and connect (pre-charged) refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Duct Connections: Duct installation requirements are specified in Section 23 31 13 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 23 33 00 "Air Duct Accessories."

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.04 STARTUP SERVICE

A. Perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.

3.06 DEMONSTRATION

A. Train Contracting Agency's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 81 26

SECTION 23 81 46

WATER-SOURCE UNITARY HEAT PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Unitary heat pumps with refrigerant-to-water heat exchangers, refrigeration circuits, and refrigerant compressor(s).

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

1.03 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For water-source unitary heat pumps, accessories, and components, from manufacturer.

B. Field quality-control reports.

C. Sample Warranty: For manufacturer's warranty.

1.04 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.05 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of water-source unitary heat pumps that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, refrigeration components.
   2. Warranty Period: Four years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance:
   1. ASHRAE 15.

B. Comply with NFPA 70.

C. Comply with safety requirements in UL 484 for assembly of free-delivery, water-source heat pumps.

2.02 WATER-SOURCE UNITARY HEAT PUMPS, 6 TONS AND SMALLER

A. Manufacturers:

B. Subject to compliance with requirements, provide products by one of the following:

C. Bosch (Basis of Design)

D. Carrier.

E. ClimateMaster.

F. Florida Heat Pump

G. Trane.

H. Description: Packaged water-source unitary heat pump with temperature controls; factory assembled, piped, wired, tested, and rated according to ASHRAE/ARI/ISO-13256-1.
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

I. Cabinet and Chassis: Galvanized-steel casing with the following features:
   1. Access panel for access and maintenance of internal components.
   2. Knockouts for electrical and piping connections.
   3. Cabinet Insulation: Glass-fiber liner, minimum 1/2 inch thick, complying with UL 181, ASTM C1071, and ASTM G21.

J. Water Circuits:
   1. Refrigerant-to-Water Heat Exchangers:
      a. Source-side coaxial heat exchangers with copper water tube, with enhanced heat-transfer surfaces inside a steel shell; both shell and tube are leak tested to 450 psig on refrigerant side and 400 psig on water side.
      b. Load-side coaxial heat exchangers with copper water tube, with enhanced heat-transfer surfaces inside a steel shell; both shell and tube are leak tested to 450 psig on refrigerant side and 400 psig on water side.

K. Refrigerant Circuit Components:
   1. Sealed Refrigerant Circuit: Charge with R-410A refrigerant.
   2. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.
   3. Charging Connections: Service fittings on suction and liquid for charging and testing on each circuit.
   4. Reversing Valve: Four-way, solenoid-activated valve designed to be fail-safe in heating position with replaceable magnetic coil.
   5. Compressor:
      a. Scroll.
      b. Single stage.
      c. Installed on vibration isolators and mounted on a structural steel base plate and full-length channel stiffeners.
      d. Exterior of compressor shall be wrapped with a high-density sound-attenuating blanket and housed in an acoustically treated enclosure.
      e. Factory-Installed Safeties:
         1) Antirecycle timer.
         2) High-pressure cutout.
         3) Low-pressure cutout or loss of charge switch.
         4) Internal thermal-overload protection.
         5) Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below 35 deg F.
         6) Water-coil, low-temperature switch.
   6. Refrigerant Piping Materials: ASTM B743 copper tube with wrought-copper fittings and brazed joints.
   7. Pipe Insulation: Refrigerant minimum 3/8-inch- thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-developed indexes according to ASTM E84.
   8. Refrigerant Metering Device: Thermal-expansion valve.
   9. Refrigerant Metering Device: Dual-port, thermal-expansion valve to allow specified operation with entering-water temperatures from 25 to 125 deg F.

L. Controls: Control equipment and sequence of operation are specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC" and Section 23 09 93.11 "Sequence of Operations for HVAC DDC."

M. Controls:
   1. Basic Unit Control Modes and Devices:
      a. Unit shutdown on high or low refrigerant pressures.
      b. Unit shutdown on low water temperature.
      c. Low- and high-voltage protection.
      d. Overcurrent protection for compressor.
      e. Random time delay, three to 10 seconds, start on power-up.

f. Time delay override for servicing.
g. Control voltage transformer.
h. Water-coil freeze protection (selectable for water or antifreeze).
i. Automatic intelligent reset. Unit shall automatically reset five minutes after trip if the fault has cleared. Should a fault reoccur three times sequentially, lockout requiring manual reset occurs.
j. Ability to defeat time delays for servicing.
k. Digital display to indicate high pressure, low pressure, low voltage, and high voltage.
l. The low-pressure switch shall not be monitored for the first 90 seconds after a compressor start command to prevent nuisance safety trips.
m. Remote fault-type indication at thermostat.
n. Selectable 24-V dc or pilot duty dry contact alarm output.
o. 24-V dc output to cycle a motorized water valve with compressor contactor.
p. Service test mode for troubleshooting and service.
q. Unit-performance sentinel warns when heat pump is running inefficiently.
r. Compressor soft start.

2. Thermostat:
   a. Wall-Mounted Thermostat:
      1) Concealed temperature indication.
      2) Deg F indication.
   b. Wall-mounted temperature sensor.
   c. Unoccupied period override push button.
   d. Data entry and access port.
      1) Input data include room temperature and humidity set points for occupied and unoccupied periods.
      2) Output data include room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.
3. Terminal Controller:
   a. Scheduled operation for occupied and unoccupied periods on 365-day clock with minimum of four programmable periods per day.
   b. Two-hour unoccupied override period.
   c. Remote-control panel to contain programmable timer and digital display for fault condition.
   d. Compressor-disable relay to stop compressor operation for demand limiting or switch to unoccupied operation.
   e. Automatic restart after five minutes if fault clears. Lockout after three attempts to restart following fault. Indicate fault for service technician.
   f. Backup for volatile memory.

N. Electrical Connection: Single electrical connection.

O. Capacities and Characteristics: See schedule on plans.

2.03 ACCESSORIES

A. Hose Kits: Tag hose kits to equipment designations.
   1. Minimum Working Pressure: 400 psig.
   2. Operating Temperatures: From 33 to 211 deg F.
   3. Hose Length: 24 inches.
   4. Minimum Hose Diameter: Equal to water-source unitary heat-pump piping connection.
   5. Hose Material: Braided stainless steel with adapters for pipe connections.
   6. Motorized Water Valve: Stop water flow through the unit when compressor is off. Slow-acting, 24-V dc valve with threaded connections is installed between isolation valves and heat exchanger.

PART 3 EXECUTION

3.01 INSTALLATION

A. Equipment Mounting:
   1. Comply with requirements for vibration-isolation and seismic-restraint devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

B. Suspend water-source, unitary heat pumps from structure with all-thread hanger rods and spring hangers with vertical-limit stop. Hanger rods and attachments to structure are specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

C. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls or as required in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC."

D. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
   1. Connect supply and return hydronic piping to heat pump with hose kits.

E. Install electrical devices furnished by manufacturer but not specified to be factory mounted.

F. Install piping adjacent to machine to allow space for service and maintenance.

3.02 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections:
   1. After installing water to water heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.
   2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Heat pumps will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 23 81 46

SECTION 23 82 16
AIR COILS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The following types of air coils that are not an integral part of air handling units:
   1. Electric.

1.02 OTHER REQUIREMENTS

A. See Section 23 00 00 “General Mechanical Requirements” for additional requirements for this Section.

1.03 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil. Include rated capacity and pressure drop for each air coil.

B. Shop Drawings: Diagram power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.

B. Field Quality Control Test Reports: Provide.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

1.07 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance:
   1. Comply with ASHRAE 15 for refrigeration system safety.
   2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
   3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - “Systems and Equipment,” and Section 7 - “Construction and Startup.”

PART 2 PRODUCTS

2.01 ELECTRIC COILS (DH-1 TO 4)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brasch.
   2. Chromalox.
   3. Dunham-Bush.
   4. INDEECO.
   5. Trane.

B. Coil Assembly: Comply with UL 1995.

C. Heating Elements: Open-coil resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, and fastened to supporting brackets.

D. High-Temperature Coil Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box without removing heater from duct or casing.
   1. Secondary Protection: Load-carrying, manually reset or manually replaceable, thermal cutouts; factory wired in series with each heater stage.

E. Frames: Galvanized-steel channel frame, minimum 0.052 inch thick for slip-in mounting.

F. Control Panel: Unit mounted with disconnecting means and over-current protection. Include the following controls:
   1. Magnetic contactor.
   2. Step controller.
   3. Time-delay relay.
   4. Airflow proving switch.

G. Thermostat: Refer to Section 23 09 00 “Instrumentation and Control for HVAC” for thermostat.

H. Thermostat Temperature Range: Wall-mounted thermostats, with temperature range from 50 to 90 degrees F, and 2.5 degrees F throttling range.

I. Capacities and Characteristics:
   1. Coil Face Dimensions:
      a. Finned Length: See Equipment Schedule on Drawings.
      b. Finned Width: See Equipment Schedule on Drawings.
   2. Mounting: Slip in.
   3. Air Side: See Equipment on Drawings.
   4. Electrical Characteristics: See Equipment on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. General: Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.

B. Corrections: Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install coils level and plumb.

B. SMACNA: Install coils in metal ducts and casings constructed according to SMACNA’s “HVAC Duct Construction Standards, Metal, and Flexible.”

C. Cleaning: Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.03 CONNECTIONS

A. General: Piping installation requirements are specified in other sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Service and Maintenance: Install piping adjacent to coils to allow service and maintenance.

C. Grounding: Ground equipment according to Section 26 05 26 “Grounding and Bonding for Electrical Systems.”

D. Low Voltage Wiring: Connect wiring according to Section 26 05 19 “Low-Voltage Electrical Power Conductors and Cables.”

3.04 FIELD QUALITY CONTROL

A. Tests and Inspections: Perform the following field tests and inspections and prepare test reports:
   1. Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 23 82 16

SECTION 23 82 39.13
CABINET UNIT HEATERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cabinet unit heaters with centrifugal fans and electric-resistance heating coils.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:
   1. Include plans, elevations, sections, and details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include location and size of each field connection.
   4. Include details of anchorages and attachments to structure and to supported equipment.
   5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
   6. Indicate location and arrangement of piping valves and specialties.
   7. Indicate location and arrangement of integral controls.
   8. Wiring Diagrams: Power, signal, and control wiring.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Structural members to which cabinet unit heaters will be attached.
   2. Method of attaching hangers to building structure.
   3. Perimeter moldings for exposed or partially exposed cabinets.

B. Field quality-control reports.

1.04 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 PRODUCTS (EUH-1 AND 5)

2.01 MANUFACTURERS

A. Manufacturers:

B. Subject to compliance with requirements, provide products by one of the following:

C. King

D. Chromalox.

E. Indeeco.

F. Markel.

G. Trane.

2.02 DESCRIPTION

A. Factory-assembled and -tested unit complying with AHRI 440.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. UL: Comply with UL 2021.

2.03 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.04 CABINETS

A. Material: Steel with factory standard finish.
   1. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch- thick galvanized sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
   2. Recessed Flanges: Steel, finished to match cabinet.
   3. Control Access Door: Key operated.

2.05 CONTROLS

A. Fan and Motor Board: Removable.
   1. Fan: Forward curved, double width, centrifugal, directly connected to motor; thermoplastic or painted-steel wheels and aluminum, painted-steel, or galvanized-steel fan scrolls.
   2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
   3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

B. Control devices and operational sequences are specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC" and Section 23 09 93.11 "Sequence of Operations for HVAC DDC."

C. DDC Terminal Controller: See control sequence on drawings.

D. Interface with DDC System for HVAC Requirements: See control sequence on drawings.

E. Electrical Connection: Factory-wired motors and controls for a single field connection.

2.06 CAPACITIES AND CHARACTERISTICS

1. Horizontal, Fully Recessed:
   a. Air Inlet: Front, punched louver.
   b. Air Outlet: Front, punched louver.

B. Fan: See schedule on plans.

C. Heating Capacity: See schedule on plans.

D. Electrical Characteristics for Single-Point Connection: See schedule on plans.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 07 92 00 "Joint Sealants."

B. Install cabinet unit heaters to comply with NFPA 90A.

C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.03 CONNECTIONS

A. Comply with safety requirements in UL 1995.

B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 23 82 39.16

This page intentionally left blank

SECTION 23 82 39.19
WALL AND CEILING UNIT HEATERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:
   1. Include plans, elevations, sections, and details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include details of anchorages and attachments to structure and to supported equipment.
   4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
   5. Wiring Diagrams: Power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.03 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 PRODUCTS (EUH-2, 3, 4 AND 9)

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:
   1. King.
   2. Chromalox.
   3. Indeeco.
   4. Markel.
   5. Trane.

2.02 DESCRIPTION

A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.03 CABINET

A. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.

B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

C. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.04 COIL

A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection

2.05 FAN AND MOTOR

A. Fan: Aluminum propeller directly connected to motor.

B. Motor: Permanently lubricated. Comply with requirements in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

2.06 CONTROLS

A. Controls: Unit-mounted thermostat. Low-voltage relay with transformer kit.

B. Electrical Connection: Factory wire motors and controls for a single field connection.

2.07 CAPACITIES AND CHARACTERISTICS SEE SCHEDULE ON PLANS

PART 3 EXECUTION

3.01 INSTALLATION

A. Install wall and ceiling unit heaters to comply with NFPA 90A.

B. Install wall and ceiling unit heaters level and plumb.

C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

D. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 23 82 39.19

SECTION 23 83 16

RADIANT-HEATING HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Radiant-heating piping, including the following:
   1. PEX pipe and fittings.
   2. Distribution manifolds.
   3. Piping specialties.
   4. Controls.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include data for piping, fittings, manifolds, specialties, and controls; include pressure and temperature ratings, oxygen-barrier performance, fire-performance characteristics, and water-flow and pressure-drop characteristics.

B. Shop Drawings: Show piping layout and details drawn to scale, including valves, manifolds, controls, and support assemblies, and their attachments to building structure.

1.03 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 PRODUCTS

2.01 PEX PIPE AND FITTINGS

A. Manufacturers:

B. Subject to compliance with requirements, provide products by one of the following:
   1. Uponor.
   2. In-floor Radiant Floor Heating.
   3. Watts Radiant.

C. Pipe Material: PEX plastic according to ASTM F876.

D. Oxygen Barrier: Limit oxygen diffusion through the tube to maximum 0.10 mg per cu. m/day at 104 deg F according to DIN 4726.

E. Fittings: ASTM F1807, metal insert and copper crimp rings.

F. Pressure/Temperature Rating: Minimum 100 psig and 180 deg F.

2.02 DISTRIBUTION MANIFOLDS

A. Manifold: Minimum NPS 1, brass or stainless steel.

B. Main Shutoff Valves:
   1. Factory installed on supply and return connections.
   2. Two-piece body.
   3. Body: Brass or bronze.
   4. Ball: Chrome-plated bronze.
   5. Seals: PTFE.
   6. CWP Rating: 150 psig.
   7. Maximum Operating Temperature: 225 deg F.

C. Manual Air Vents:
   1. Body: Bronze.
   2. Internal Parts: Nonferrous.
   3. Operator: Key furnished with valve, or screwdriver bit.
   4. Inlet Connection: NPS 1/2.
   5. Discharge Connection: NPS 1/8.
   6. CWP Rating: 150 psig.

7. Maximum Operating Temperature: 225 deg F.

D. Balancing Valves:
1. Body: Plastic or bronze, ball or plug, or globe cartridge type.
2. Ball or Plug: Brass or stainless steel.
3. Globe Cartridge and Washer: Brass with EPDM composition washer.
4. Seat: PTFE.
5. Visual Flow Indicator: Flowmeter with visible indication in a clear plastic cap at top of valve.
6. Differential Pressure Gage Connections: Integral seals for portable meter to measure loss across calibrated orifice.
7. Handle Style: Lever or knob, with memory stop to retain set position if used for shutoff.
8. CWP Rating: Minimum 125 psig.
9. Maximum Operating Temperature: 250 deg F.

E. Zone Control Valves:
1. Body: Plastic or bronze, ball or plug, or globe cartridge type.
2. Ball or Plug: Brass or stainless steel.
3. Globe Cartridge and Washer: Brass with EPDM composition washer.
4. Seat: PTFE.
5. Actuator: Replaceable electric motor.
6. CWP Rating: Minimum 125 psig.
7. Maximum Operating Temperature: 250 deg F.

F. Thermometers:
1. Mount on supply and return connections.
2. Case: Dry type, metal or plastic, 2-inch diameter.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, connecting element and pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Black metal.
7. Window: Plastic.
8. Connector: Rigid, back type.
9. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem.
10. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

G. Mounting Brackets: Copper, or plastic- or copper-clad steel, where in contact with manifold.

2.03 PIPING SPECIALTIES

A. Cable Ties:
1. Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
2. Minimum Width: 1/8 inch.
3. Tensile Strength: 20 lb, minimum.
4. Temperature Range: Minus 40 to plus 185 deg F.

PART 3 EXECUTION

3.01 APPLICATIONS

A. Install the following types of radiant-heating piping for the applications described:
1. Piping in Interior Reinforced-Concrete Floors: PEX.

3.02 INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings or coordination drawings.

B. Install radiant-heating piping continuous from the manifold through the heated panel and back to the manifold without piping joints in heated panels.

C. Connect radiant piping to manifold in a reverse-return arrangement.

D. Do not bend pipes in radii smaller than manufacturer's minimum bend radius dimensions.

E. Install manifolds in accessible locations, or install access panels to provide maintenance access as required in Section 08 31 13 "Access Doors and Frames."

F. See Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties" for pipes and connections to hydronic systems and for glycol-solution fill requirements.

G. Fire- and Smoke-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials according to Section 07 84 13 "Penetration Firestopping."

H. Piping in Interior Reinforced-Concrete Floors:
   1. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties.
   2. Space cable ties a maximum of 18 inches o.c. and at center of turns or bends.
   3. Maintain 2-inch minimum cover.
   4. Install a sleeve of 3/8-inch- thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
   5. Maintain minimum 40-psig pressure in piping during concrete placement and continue for 24 hours after placement.

I. Revise locations and elevations from those indicated as required to suit field conditions and ensure integrity of piping and as approved by Architect.

J. After system balancing has been completed, mark balancing valves to permanently indicate final position.

K. Perform the following adjustments before operating the system:
   1. Open valves to fully open position.
   2. Check operation of automatic valves.
   3. Set temperature controls so all zones call for full flow.
   4. Purge air from piping.

L. After concrete or plaster heating panel has cured as recommended by concrete or plaster supplier, operate radiant-heating system as follows:
   1. Start system heating at a maximum of 10 deg F above the ambient radiant-panel temperature and increase 10 deg F each following day until design temperature is achieved.
   2. For freeze protection, operate at a minimum of 60 deg F supply-water temperature.

3.03 FIELD QUALITY CONTROL

A. Prepare radiant-heating piping for testing as follows:
   1. Open all isolation valves and close bypass valves.
   2. Open and verify operation of zone control valves.
   3. Flush with clean water and clean strainers.

B. Perform the following tests and inspections:
   1. Leak Test: After installation, charge system and test for leaks. Subject piping to hydrostatic test pressure that is not less than 1.5 times the design pressure but not more than 100 psig. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Radiant-heating piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Protect hydronic piping system from damage during construction.

END OF SECTION 23 83 16

SECTION 23 83 23
RADIANT-HEATING ELECTRIC PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Prefabricated radiant-heating electric panels.

1.02 RELATED DOCUMENTS

A. Section 23 00 00 "General Mechanical Requirements."

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For electric heating panels.
   1. Include plans, sections, details, and attachments to other work.
   2. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Structural members to which heating panels and suspension systems will be attached.
   4. Size and location of initial access modules for acoustical tile.
   5. Items installed in finished ceiling, including the following:
      a. Lighting fixtures.
      b. Sprinklers.

B. Field Quality Control Reports: Provide.

C. Sample Warranty: For special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric heating panels to include in operation and maintenance manuals.

1.06 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace electric heating panels that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Three years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR RADIANT-HEATING ELECTRIC PANELS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 PREFABRICATED RADIANT-HEATING ELECTRIC PANELS (EUH-6 TO 8)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Invizatherm
   2. Berko.
   3. QMark.

B. Description: Sheet-metal-enclosed panel with heating element suitable for surface mounting. Comply with UL 2021.
   1. Panel: Minimum 0.0276-inch-thick, galvanized sheet steel back panel riveted to minimum 0.0396-inch-thick, galvanized sheet steel front panel with fused-on crystalline surface.

2. Heating Element: Insulated resistive wires.
3. Electrical Connections: Non-heating, high-temperature, insulated-copper leads, factory connected to heating element.
4. Surface-Mounted Trim: Sheet metal with baked enamel finish in manufacturer's standard paint color as selected by Owner's Representative.

C. Wall Timer: Heavy duty in-wall timer with dial time setting.

D. Capacities and Characteristics:
1. Nominal Panel Size: 24.00 by 48.00 inches.
2. Heating Capacity: See Equipment Schedule on Drawings.
3. Electrical Characteristics for Single-Point Connection:
a. Volts: See Equipment Schedule on Drawings.
b. Phase: See Equipment Schedule on Drawings.
c. Hertz: See Equipment Schedule on Drawings.
d. Full-Load Amperes: See Equipment Schedule on Drawings.
e. Minimum Circuit Ampacity: See Equipment Schedule on Drawings.
f. Maximum Over-current Protection: See Equipment Schedule on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. General: Examine surfaces and substrates to receive electric heating panels for compliance with requirements for installation tolerances and other conditions affecting performance.
1. Ensure surfaces in contact with electric heating panels are free of burrs and sharp protrusions.
2. Ensure surfaces and substrates are level and plumb.

B. Corrections: Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install radiant-heating panels level and plumb.
1. Install at least one independent support rod or wire from structure to a tab on panel. Wire or rod shall have breaking strength of the weight of the panel at a safety factor of 3.

B. Timer Locations: Verify locations of timers with Drawings and room details before installation. Install devices 48.00 inches above finished floor.

3.03 CONNECTIONS

A. Grounding: Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:
1. Operate electric-heating elements through each stage to verify proper operation and electrical connections.
2. Test and adjust controls and safeties.

C. Defective Panels: Radiant-heating electric panels will be considered defective if they do not pass tests and inspections.

D. Test and Inspection Reports: Provide.

3.05 PROTECTION

A. Protection: Protect installed radiant-heating electric panels from damage during construction.

B. Damaged Panels: Remove and replace damaged radiant-heating electric panels.

END OF SECTION 23 83 23

SECTION 26 00 00
GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE

A. Basic electrical requirements specifically applicable to Division 26 Sections.

B. Work includes but is not necessarily limited to the following:
   1. Labor, materials, services, equipment, and appliances required for completion of tasks as indicated on drawing or in specification or as inherently necessary to provide complete and operational electrical systems including:
      a. All temporary construction power including construction trailer, crane, test power, temporary heat and lighting, or any construction machine will require coordination with utility and obtain temporary power to site;
      b. Contractor shall provide complete pathways for utility to bring the temporary and permanent utility transformer to site for installation.
      c. Incidental items not indicated on the drawings nor mentioned in the Specifications that belong to the work described, or are required to provide complete and operable systems, as though called out here in every detail;
      d. Cleaning, cutting, patching, repairing and painting;
      e. Testing and commissioning;
      f. The Contractor shall coordinate this Section with all other Sections of the Specification.
      g. Solar PV system design, calculations and installation shall be deferred submittal. Provide 99.5kW of rooftop solar PV system as deferred submittal. Contractor shall include 5KW rooftop solar photovoltaics in the base bid contract and remaining 94.5KW shall be alternate bid. Contractor shall include cost of all required balance of systems and accessories to provide a complete functional solar PV system for the building. All building systems shall be installed to accommodate the solar PV system.
      h. Fire alarm system selections, design, calculations and installation will be delegated and deferred submittal.
      i. All structural mounting and anchorages of electrical and fire alarm equipment will be a deferred submittal for contractor to design and install based on EEOR approved equipment for construction.

1.02 DRAWINGS AND SPECIFICATIONS

A. Drawings accompanying these Specifications show intent of Work to be done. Specifications shall identify quality and grade of installation and where equipment and hardware is not particularly specified, Contractor shall provide submittals for all products and install them per manufacturers' recommendations, and in a workmanlike manner.

B. In the event of a conflict or inconsistency between items indicated on the plans and/or specifications or with code requirements, the note, specification or code which prescribes and establishes the more complete job or the higher standard prevail.

C. Plans are intended to show general arrangement and extent of Work contemplated. Exact location and arrangement of parts shall be determined after the Contracting Agency has reviewed equipment, as Work progresses, to conform in best possible manner with surroundings, and as directed by the Contracting Agency.

D. For purposes of clearness and legibility, the electrical drawings are essentially diagrammatic. The size and location of equipment is shown to scale where possible. The contractor shall verify all conditions, data information as indicated on the drawings and in the specification sections where electrical work interfaces with other trades.

E. Contract Documents are intended to show the scope and general arrangement of the Work under this Contract. Drawings are not intended to be scaled for roughing in measurements or to serve as shop drawings. Where job conditions require minor changes or adjustments in the

indicated locations or arrangement of the Work, such changes shall be made without change in the Contract amount.

F. The contractor shall maintain as built drawings to reflect all changes made during construction and any deviations from the electrical drawings. This includes deviations from circuit numbers and any addition, deletion or relocation of fixtures/outlets shown on working drawings.

1.03 UTILITIES

A. Location and sizes of electrical, mechanical and plumbing service facilities are shown in accordance with data secured from existing record drawings and site observations. Data shown are offered as an estimating guide without guarantee of accuracy. Check and verify all data given, and verify exact location of all utility services pertaining to Work prior to excavation or performing Work.

1.04 APPLICABLE REFERENCE STANDARDS, CODES AND REGULATIONS

A. The Washington State:
   1. Current International Building Code
   2. Current International Mechanical Code
   3. Current International Fire Code
   4. Current National Electrical Code, including the adoption and amendment of the National Electrical Code from Department of Labor and Industries.
   5. Current Uniform Plumbing Code
   6. Current Washington State Energy Code

B. Additional Referenced Standards:
   1. ANSI American National Standards Institute
   2. IEEE Institute of Electrical and Electronic Engineers
   3. NEMA National Electrical Manufacturer's Association
   4. NFPA National Fire Protection Association Standards
   5. UL Underwriters Laboratories

C. Codes and ordinances having jurisdiction over Work are minimum requirements; but, if Contract Documents indicate requirements, which are in excess of those minimum requirements, then requirements of the Contract Documents shall be followed. Nothing in these drawings and specifications shall be construed to permit work not conforming to governing codes or regulations. Should there be any conflicts between Contract Documents or codes or any ordinances having jurisdiction, report these to the Contracting Agency.

D. Obtain permits, and request inspections from authority having jurisdiction.

1.05 PROJECT AND SITE CONDITIONS

A. The arrangement of and connection to equipment shown on the Drawings is based upon information available and is not intended to show exact dimensions peculiar to a specific manufacturer. The Drawings are, in part, diagrammatic and some features of the illustrated equipment installations may require revision to meet actual equipment installation requirements. Structural supports, housekeeping pads, piping connections and adjacent equipment may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions or alterations.

B. Examine all Drawings and Specifications to be fully cognizant of all work required under this Division.

C. Examine site related work and surfaces before starting work of any Section.

D. Install Work in locations shown on approved Drawings, unless prevented by Project conditions.

E. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission from the Contracting Agency before proceeding.

1.06 COOPERATION WITH WORK UNDER OTHER DIVISIONS

A. Cooperate with other trades to facilitate general progress of Work. Allow all other trades every reasonable opportunity for installation of their work.

B. Work under this Division shall follow general building construction closely. Set pipe sleeves and inserts and verify that openings for chases and pipes are provided.

C. Work with other trades in determining exact location of outlets, conduits, pipes, and pieces of equipment to avoid interference with lines required to maintain proper installation of Work.

D. Make such progress in the Work to not delay work of other trades.

1.07 DISCREPANCIES

A. The contractor shall check all drawings furnished to him immediately upon their receipt and shall promptly notify the Contracting Agency of any discrepancies. Figures marked on drawings shall in general be followed in preference to scale measurements. Large scale drawings in general govern small scale drawings. The contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby. Where no figures or notations are given, the plans shall be followed

B. Omissions from the Drawings or Specifications or the erroneous description of details of work which are manifestly necessary to carry out the intent of the Drawings and Specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or erroneously described details of the work but they shall be performed as if fully and correctly set forth and described in the drawings and specifications.

C. If any part of the Specifications or Drawings appears unclear or contradictory, apply to Contracting Agency for interpretation and decision as early as possible, including during bidding period. Do not proceed with such work without Contracting Agency Representatives decision. Beginning work of any Section constitutes acceptance of conditions.

1.08 CHANGES

A. The Contractor shall be responsible to make and obtain approval from the Contracting Agency for all necessary adjustments in piping and equipment layouts as required to accommodate the relocations of equipment and/or devices, which are affected by any approved authorized changes or Product substitutions. All changes shall be clearly indicated on the "Record" drawings.

1.09 SUBMITTALS

A. Refer to Section 1-06 for additional requirements.

B. The manufacturer, contractor or supplier shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of that particular specification section.

C. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section.

D. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

E. Note that prior to acceptance of submittals for review, a submittal schedule shall be submitted to the Contracting Agency.

F. Submit all Division 26 shop drawings and product data grouped and referenced by the specification technical section number in one complete submittal package.

G. Shop Drawings:
   1. Include installation details of equipment indicating proposed location, layout and arrangement, accessories, piping, and other items that must be shown to assure a coordinated installation.
   2. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
   3. If equipment is rejected, revise drawings to show acceptable equipment and resubmit.

4. Whenever more than one (1) manufacturer's product is specified, the first named product is the basis of design used in the Drawings and the use of alternate-named manufacturer's products or substitutes may require modifications to the design.
5. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Contracting Agency bearing the Contracting Agency stamp of "Reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the Contracting Agency without additional compensation.
6. Manufacturer's Data: For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, certified equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.
7. Standard Compliance: When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or UL, submit proof of such conformance to the Contracting Agency Representative for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the Contracting Agency Representative. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.
8. Certified Test Reports: Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.
9. Certificates of Compliance or Conformance: Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this Contract. Pre-printed certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; or "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance or conformance.

H. The Contractor shall submit all passcodes and passwords for any hardware and software required for the operations and troubleshooting in all systems and components no less than fourteen (14) calendar days prior to Final Completion.

1.10 PROJECT RECORD DOCUMENTS

A. Refer to Section 1-5.5(2) for additional requirements.
   1. All changes, deviations and information recorded on the "Project Record Drawings" set during Construction shall be marked on the "Project Record Drawings," in red ink.

1.11 PRODUCT ALTERNATIVES OR SUBSTITUTIONS

A. Refer to Section 1-06.7 for additional requirements.

1.12 OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel.

1.13 MANUFACTURER S RECOMMENDATIONS

A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

1.14 DELIVERY AND STORAGE

A. Refer to Section 1-06.4 for additional requirements.

B. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B P, Appendix I, titled "Equipment Storage and Maintenance During Construction." Replace damaged or defective items with new items.

1.15 GUARANTEE

A. Except as may be specified under other sections in the Specifications, guarantee all equipment furnished under the Specifications for a period of one year from date of project acceptance against defective workmanship and material and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the Contracting Agency.

B. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Contracting Agency for their service agency as directed.

PART 2 PRODUCTS

2.01 COMPETITIVE PRODUCTS

A. Unless otherwise noted, any reference in the Specification to any article, device, product, material, fixture, form, or type of construction by name, make, or catalog number shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. The Contractor may at his option propose substitutions for such material in accordance with the substitution procedure outlined in the Contract Documents.

2.02 MATERIALS

A. Provide all new materials and equipment, free from any defects, in first-class condition, and suitable for the space provided. Provide materials and equipment approved by UL authority having jurisdiction approved testing agency, wherever standards have been established by that agency.

B. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of units or equipment need not be products of the same manufacturer.

C. Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturers' latest standard design that conforms to these Specifications.

D. Provide materials and equipment with manufacturers' standard finish system, except where otherwise specified. Provide manufacturers' standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment with ANSI Number 61, light gray color.

E. Environmental and Seismic Conditions: Material and Equipment shall be designed to insure satisfactory operation and operational life in the environmental and seismic conditions which will prevail where they are being installed. Electrical equipment and enclosures shall be designed, constructed and certified to withstand external loading conditions as prescribed by the Washington State Building Code for the locations of the equipment. Supplied equipment shall either be shake table tested and certified or comprehensive seismic calculations shall be provided. All seismic calculations and structural drawings shall bear the seal of a Structural Professional Engineer currently licensed in the State of Washington.

PART 3 EXECUTION

3.01 GENERAL

A. Obtain and pay for all permits and inspections, including any independent testing required to verify standard compliance, and deliver certificates for same to the Contracting Agency.

3.02 WORK RESPONSIBILITIES

A. The drawings indicate diagrammatically the desired locations or arrangement of piping, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions.

B. The Contractor is responsible for the correct placing of Work and the proper location and connection of Work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.

C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the construction or rearrangement of furnishings or equipment, such changes shall be made without extra cost, providing the change is ordered before the conduit runs, etc. and work directly connected to same is installed and no extra materials are required.

D. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.

E. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.

F. Should any changes to the Work indicated on the Drawings or described in the Specifications be necessary in order to comply with the above requirements, notify the Contracting Agency immediately and cease work on all parts of the contract, which are affected until approval for any required modifications to the construction has been obtained from the Contracting Agency.

G. Be responsible for any cooperative work, which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the Contracting Agency and shall be made to his satisfaction. Perform all Work with competent and skilled personnel.

H. The electrical drawings do not indicate all fittings, hardware, or appurtenances required for a complete operating installation.

I. Wiring diagrams are not intended to indicate the exact course of raceways.

J. One-line and riser diagrams are only schematics and do not show physical arrangements of equipment.

K. All workmanship, including aesthetic as well as electrical aspects of the Work, shall be of the highest quality consistent with the best practices of the trade.

L. Replace or repair, without additional compensation, any Work, which, in the opinion of the Contracting Agency, does not comply with these requirements.

3.03 CLEANING & PAINTING OF EQUIPMENT

A. Refer to Section 09 90 00 for additional requirements.

B. Factory Applied:
   1. Electrical equipment shall have factory-applied painting systems, which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.
   2. Refer to individual sections of this Division for more stringent requirements.

C. Field Applied: Paint electrical equipment as required to touch up, to match finish on other equipment in adjacent spaces, or to meet safety criteria.

D. After installation, all metal finishes shall be polished and cleaned of all dirt, rust, cement, plaster, grease, and paint.

END OF SECTION 26 00 00

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:
   1. Section 26 00 00 “WA General Electrical Requirements”
   2. Section 26 05 23 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2 and 3 control cables.
   3. Section 26 05 33 “Raceways and Boxes for Electrical Systems"
   4. Section 26 05 53 "Identification for Electrical Systems."

1.02 DEFINITIONS

A. ASTM: American Society of Testing Materials.

B. ICEA: Insulated Cable Engineers Association.

C. IEEE: Institute of Electrical & Electronics Engineers.

D. NEMA: National Electrical Manufacturers Association.

E. NETA ATS: InterNational Electrical Testing Association - Acceptance Testing Specification.

F. VFD: Variable frequency drive.

1.03 ACTION SUBMITTALS

A. Product Data: Submit manufacturer’s technical data for each type of product, indicating conductor/cable construction, insulation material, thickness of insulation, jacket, cable stranding, and voltage rating of each type of conductor/cable specified, splices and terminations. Indicate date and place of manufacture for each conductor/cable, cable, splice and termination.

B. Manufacturer’s ISO certification.

C. Product Cable Schedule: Indicate type, use, location, and termination locations.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Independent Testing Agency.

B. Field quality-control reports. Perform field testing of cables per para 3.8. Submit six (6) copies of field test reports to Contracting Agency within two (2) weeks of completion of test.

1.05 QUALITY ASSURANCE

A. General Requirements: The low voltage power conductors and cable shall be copper, minimum 600V rated unless otherwise indicated. Aluminum conductors and cables shall not be accepted unless otherwise indicated.

B. Materials and installation shall meet or exceed requirements in the following referenced standards and shall be listed and labelled by UL.
   1. ICEA S-95-658/ NEMA WC 70.
   2. UL 1072.
   3. IEEE.
   4. ASTM.
   5. NEMA.

C. Conductors and cables shall be of the same manufacturer and shipped to the job site in original unbroken reels.

D. Conductors and cables shall be manufactured with in twelve (12) months of installation. Date of manufacture shall be clearly marked on conductors or conductor reels.

E. Manufacturer shall have minimum ten (10) years experience in the manufacturer of conductors and cables similar to those specified on this project.

F. Manufacturer shall have ISO 9001 and ISO 9002 certification.

G. All conductors and cables shall be new and supplied by a local distributor.

H. If alternate manufacturer of products other than what are specified in this section are submitted, all necessary documents not limited to cut sheets, technical information, test reports from recognized testing labs and factory test reports shall be submitted to the satisfaction of the Contracting Agency/engineer to ensure quality and conformance to the specifications. Additional testing shall be undertaken if it is concluded by the Contracting Agency/engineer that the submitted test reports are either insufficient or do not include all tests necessary for product acceptance. The tests shall be conducted by a recognized lab acceptable to the Contracting Agency/engineer and all tests shall be witnessed by Contracting Agency's/engineer's personnel. All testing procedures and test results shall be satisfactory to the Contracting Agency/engineer. Contractor shall be responsible for arranging the tests, for transportation, food and lodging for minimum of one Contracting Agency's/engineer's representative to witness the test at the testing lab. Include all costs for the above in the bid.

I. Testing: Provide the services of an independent qualified testing laboratory to perform the specified field tests. Notify the University's Representative fourteen (14) days in advance of performance of work requiring testing.

J. Conductors, cables, splices and terminations shall be manufactured within twelve (12) months of installation. Each item shall have a permanent marking on the product or the original manufacturers' package indicating the date of manufacture unless otherwise noted.

K. Testing Agency Qualifications:
   1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of last ten (10) years and has permanent in-house testing engineers and technicians involved with testing of low voltage electrical power conductors and cables similar to those specified on this project.
   2. Testing company shall be located with 50 miles radius of the project.
   3. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
   4. Field Testing technician and supervisor shall have minimum ten (10) years' experience in field testing of low voltage power conductors and cables of the type and rating similar to the conductors and cables to be tested on this project.

PART 2 PRODUCTS

2.01 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

B. Basis-of-Design Product:
   1. General Cable Technologies Corporation.
   2. Southwire Incorporated.
   3. Alpha Wire.
   4. Belden Inc.
   5. Encore Wire Corporation.

C. Conductor Material: Electrical grade, soft drawn annealed copper, 98 percent conductivity, and fabricated in accordance with ASTM and ICEA standards. Minimum size is number 12 for branch circuits, number 14 stranded for control wiring. Aluminum conductors are not permitted. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

D. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.

E. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC with ground wire.

F. VFD Cable:
   1. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable.
   2. Type TC-ER with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.
   3. Comply with UL requirements for cables in Classes I and II, Division 2 hazardous location applications.

G. Provide separate neutral with each branch circuit serving outlets. When dedicated neutrals are provided, use color spiral to match associated phase.

2.02 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Ideal Industries, Inc.
   2. Ilsco
   3. NSi Industries LLC.
   4. O-Z/Gedney; a brand of Emerson Industrial Automation.
   5. 3M; Electrical Markets Division.
   6. TE Connectivity - Raychem.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

C. Copper conductors shall be terminated in copper or bronze mechanical connectors or lugs or tool applied compression connections made of copper for all connections except those on wiring devices.

D. Splices in wires No. 10 and smaller shall be made with twist-on splicing connector in accordance with UL486-C. Connections in wires No. 8 and larger shall be made with compression type connectors in accordance with UL486-A and wrapped with insulated tape in accordance with UL501. Insulating tape shall be applied in a minimum of two layers of half wrap or built to match the overall insulation of the wire.

E. Splices in underground pull boxes shall be made submersible type and made using “3M” Scotch-cast epoxy kits.

F. Pressure type connectors are not permitted.

2.03 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFD cable, which shall be extra flexible stranded.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway

B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

E. Feeders Installed below Raised Flooring: Type THHN-2-THWN-2, single conductors in raceway

F. Feeders in Cable Tray: TC rated, Type THHN-2-THWN-2, single conductors in raceway.

G. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.

I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

J. Branch Circuits Installed Below Raised Flooring: Type THHN-2-THWN-2, single conductors in raceway.

K. Branch Circuits in Cable Tray: TC rated Type THHN-2-THWN-2, single conductors in raceway

L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

M. VFD Output Circuits: Type XHHW-2 in metal conduit.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. All conductors and cables shall be installed in a raceway.

B. Before installing conductors and cables in existing conduits, verify the continuity of each conduit; each surface conduit is properly supported per code and clear of any debris.

C. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

D. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

G. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

H. Complete cable tray systems installation according to Section 26 05 36 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.05 IDENTIFICATION

A. Each conductor shall be factory color coded by conductor manufacturer. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.07 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 00 " Firestopping."

3.08 FIELD QUALITY CONTROL

A. Testing Agency: Engage an independent qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:
   1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance conductors, feeder conductors and the conductors feeding the following critical equipment and services for compliance with requirements.
   2. Perform each visual and mechanical inspection and electrical tests stated in latest NETA Acceptance Testing Specification section 7.3.2 (Inspection and Test Procedures-Cables, Low Voltage-600V Maximum). Certify compliance with test parameters per NETA tables.
   3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
      a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
      b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
      c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Test and Inspection Reports: Prepare a written report to record the following:
   1. Procedures used.
   2. Results that comply with requirements. Include color scan images.
   3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 05 19

This page intentionally left blank

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding systems and equipment, plus the following special applications:
   1. Overhead-line grounding.
   2. Underground distribution grounding.
   3. Ground bonding common with lightning protection system.

1.02 DEFINITIONS

A. NETA ATS: InterNational Electrical Testing Association - Acceptance Testing Specification.

B. NETA MTS: InterNational Electrical Testing Association - Maintenance Testing Specification.

C. NFPA : National Fire Protection Association.

D. IEEE: Institute of Electrical and Electronics Engineers

1.03 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's technical catalog cuts for each type of product indicated.

B. Shop Drawings: Site drawings to scale including details showing location and size of each field connection of grounding system.
   1. Wiring Diagrams: Differentiate between manufacturer installed and field installed wiring.

C. Sustainable Design Submittals:
   1. Product Data: For each conductor and cable indicating lead content.

1.04 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Plans drawn to scale (1/4"=1'-0") showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
   1. Test wells.
   2. Ground rods.
   3. Ground rings.
   4. Grounding conductors, connectors.
   5. Grounding arrangements and connections for separately derived systems.
   6. Grounding for sensitive electronic equipment.

B. Qualification Data: For qualified independent testing agency and testing agency's field supervisor.

C. Field quality-control reports. Submit written test reports including the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 1-11 "Operation and Maintenance Data," include the following:
   1. Instructions for periodic testing and inspection of grounding features at test wells based on **NFPA 70B**.
      a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
      b. Include recommended testing intervals.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications:
   1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of last ten (10) years and has permanent in-house testing engineers and technicians involved with testing of grounding systems similar to those specified on this project.
   2. Testing company shall be located with 50 miles radius of the project.
   3. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
   4. Field Testing technician and supervisor shall have minimum ten (10) years' experience in field testing of rounding systems of the type and rating similar to the systems to be tested on this project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 PRODUCTS

2.01 GROUNDING ELECTRODES, CONDUCTORS, CONNECTOR, BUS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:
   1. Grounding Connectors, Bars and Rods:
      a. Erico - Pentair Electrical Fastening Solutions
      b. Burndy – A Hubbell Company.
      c. Ideal Industries, Inc.
      d. O-Z/Gedney Co. - A brand of Emerson Industrial Automation.
      e. Thomas & Betts - A Member of the ABB Group.
   2. Grounding Conductors and cables:
      a. Southwire
      b. American Insulated Wire
      c. Okonite

2.02 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
   1. Solid Conductors: ASTM B 3.
   2. Stranded Conductors: ASTM B 8.
   3. Tinned Conductors: ASTM B 33.
   4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
   5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
   7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
   1. No. 4 AWG minimum, soft-drawn copper.
   2. Conductor Protector: Half-round PVC or wood molding; if wood, use pressure-treated fir, cypress, or cedar.

D. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

E. Lead Content: Less than 300 parts per million

2.03 CONNECTORS

A. Listed and labeled by UL for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors, Rods and Pipes: Copper or copper alloy, pressure type with at least two bolts.
   1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

E. Lead Content: Less than 300 parts per million

2.04 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts
   1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
   2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 EXECUTION

3.01 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned copper conductor, No. 2/0 AWG minimum.
   1. Bury at least 24 inches (600 mm) below grade.
   2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment or IT rooms, and elsewhere as indicated.
   1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
   2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

E. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Welded connectors.

3.02 GROUNDING OVERHEAD LINES

A. Comply with IEEE C2 grounding requirements.

B. Install two parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 25 ohms.

C. Drive ground rods until tops are 12 inches below finished grade in undisturbed earth.

D. Ground-Rod Connections: Install bolted connectors for underground connections and connections to rods.

E. Lightning Arrester Grounding Conductors: Separate from other grounding conductors.

F. Secondary Neutral and Transformer Enclosure: Interconnect and connect to grounding conductor.

G. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

3.03 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Install #4/0 bare copper ground wire loop around the outside perimeter of the manhole, in soil, 12” above bottom of manhole. Cadweld ground wire loop to #4/0 bare copper ground wire connecting all exposed metal parts inside the manhole through a 1” opening at the top of manhole wall. Seal and waterproof opening after wire installation.

D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

E. Pad-Mounted Transformers and Medium Voltage Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 1/0 ~~2~~ AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.04 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits in the same conduit containing phase and neutral conductors. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   4. Single-phase motor and appliance branch circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. Armored and metal-clad cable runs.
   8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment. Verify requirements with X-ray equipment supplier prior to rough-ins.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

G. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.
3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
4. All metallic conduits and cable tray shall be continuously bonded to maintain low resistance ground path and bonded back to the central equipment by the use of bonding jumpers where needed.

H. Metal and Wood Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode next to the pole and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors. Provide a handhole for the grounding electrode at each pole.

I. Metallic Fences or Other Metal Structures: Comply with requirements of IEEE C2. Bond metallic fences and other metal structures located within 8 feet (2.5 m) vertically or 16 feet (5 m) horizontally of exposed conductors or equipment.
1. Grounding Conductor: Bare, tinned-copper, not less than No. 8 AWG.
2. Gates: Shall be bonded to the gate support post with a flexible bonding jumper. Bond each gate support post to the grounding electrode system in the area.
3. Provide bond across fence openings with 2 AWG bonding jumper buried 18 inches (460 mm) minimum below finished grade. Extend local grounding electrode system to cover swing of gates.
4. Barbed Wire: Strands shall be bonded to the grounding conductor.

J. Generator (Non-Separately Derived System): Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator. Maintain separation of neutral and ground. Provide warning sign at neu-

tral to ground bond location: “WARNING: SHOCK HAZARD EXISTS IF GROUNDING ELECTRODE CONDUCTOR OR BONDING JUMPER CONNECTION IN THIS EQUIPMENT IS REMOVED WHILE ALTERNATE SOURCE IS ENERGIZED.”

K. Hospitals and Healthcare Facilities:
   1. Use metal conduits and raceway systems that qualify as a ground return path for feeders and branch circuits serving patient care areas.
   2. Provide a bonded connection at all conduit terminations and junction points for feeders supplying panelboards, switchboards, and switchgear
   3. Bond all panelboards together, serving the same patient care vicinity, with a minimum 10 AWG copper bonding conductor.

L. Isolated ground receptacles are prohibited for use in patient care areas.

3.05 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade using exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
   2. For grounding electrode system, install ground rods at least □□□□□ rods (unless otherwise indicated on the drawings), spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
   1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
   2. Test Wells near light poles: Coordinate location with landscape drawings and install one at each pole. Test well shall be open bottom and installed on a 12”H bed of gravel or crushed stone (1” size).

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding

conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Separately Derived System (SDS): All multiple branch metal water piping laterals originating from outside the area being served by the SDS and which serve the same area being served by the SDS shall be bonded to the common grounding electrode (GE) or the common grounding electrode conductor (GEC). The bonding connection shall be made at each level that the metal water piping serves. When multiple SDS's are installed or an SDS serves multiple levels of a structure, a copper common GEC shall be installed for the SDS as permitted in NFPA 70 article 250.30 (D)3 and sized per article 250.30 (A) and (B).
3. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
4. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building or area or item indicated.
1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.

J. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 2/0 AWG.
1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.06 LABELING

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.07 FIELD QUALITY CONTROL

A. Testing Agency: Engage an independent qualified testing agency to perform tests and inspections. Refer to section

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal , at ground test wells , and at individual ground rods. Make tests at ground rods before any conductors are connected.
    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 10 ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hangers and supports for electrical equipment and systems.

B. Construction requirements for concrete bases.

1.02 RELATED REQUIREMENTS

A. Section 26 05 48.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of 5 times the applied force.

1.05 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.
   2. Nonmetallic slotted support systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
   1. Trapeze hangers. Include Product Data for components.
   2. Steel slotted channel systems. Include Product Data for components.
   3. Nonmetallic slotted channel systems. Include Product Data for components.
   4. Equipment supports.

1.06 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.07 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.08 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Tube & Conduit: Part of Atkore International
      b. Cooper B-Line, Inc.; a division of Eaton Inc.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation: A Member of the ABB Group.
      f. Unistrut; Part of Atkore International,
      g. Wesanco, Inc.
   3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   6. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch-diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Tube & Conduit: a part of Atkore , International.
      b. B-Line, Inc.; an Eaton Business.
      c. Fabco Plastics Wholesale Limited.
      d. Seasafe, Inc.
   3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
   4. Fitting and Accessory Materials: Same as channels and angles
   5. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Hilti Inc.
         2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.
         4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
   2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
      a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Cooper B-Line, Inc.; a division of Cooper Industries.
         2) Empire Tool and Manufacturing Co., Inc.
         3) Hilti Inc.
         4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         5) MKT Fastening, LLC.
   3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
   4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
   5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
   6. Toggle Bolts: All-steel springhead type.
   7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 05 50 00 "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.01 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
   6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
   7. To Light Steel: Sheet metal screws.
   8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 05 50 00 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 30 00 "Cast-in-Place Concrete”

C. Anchor equipment to concrete base.
   1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 09 90 00 "Painting and Coating" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

This page intentionally left blank

SECTION 26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal conduits, tubing, and fittings.

B. Nonmetal conduits, tubing, and fittings.

C. Metal wireways and auxiliary gutters.

D. Nonmetal wireways and auxiliary gutters.

E. Surface raceways.

F. Boxes, enclosures, and cabinets.

G. Handholes and boxes for exterior underground cabling.

1.02 RELATED REQUIREMENTS

A. Retain first subparagraph below for underground conduits, handholes, and boxes; delete if incidental exterior underground raceways, handholes, and boxes are specified in this Section.

B. Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

C. Section 27 05 28 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

D. Section 28 05 28 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.03 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. EMT: Electrical metal tubing

C. ENT: Electrical non-metallic tubing

D. GRC: Galvanized rigid steel conduit.

E. HDPE: High density polyethylene pipe

F. IMC: Intermediate metal conduit.

G. LFMC: Liquidtite flexible metal conduit

H. LFNC: Liquitite flexible non-metallic conduit.

I. RNC: Rigid non-metallic conduit

J. RTRC: Reinforced thermosetting resin conduit

1.04 QUALITY ASSURANCE

A. Each conduit shall bear manufacturer’s trademark and UL label.

B. Each type of conduit and fittings shall be of a single manufacturer. Multiple manufacturer’s of the same material are not acceptable.

C. Comply with National Electric Code (NEC)

1.05 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

D. Samples: For wireways nonmetallic wireways and surface raceways and for each color and texture specified, 12 inches long.

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 PRODUCTS

2.01 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements,
1. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. Electri-Flex Company.
3. O-Z/Gedney; a brand of EGS Electrical Group.
4. Republic Conduit.
5. Robroy Industries.
6. Thomas & Betts Corporation.
7. Western Tube and Conduit Corporation.
8. Wheatland Tube Company; a division of John Maneely Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be UL listed and labeled as defined in NFPA 70 and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit
1. Comply with ANSI C80.1 ETL PVC-001,NEMA RN 1 and UL 6.
2. Coating Thickness: 0.040 inch, minimum.
3. A PVC Coated Sealing Locknut shall be used on all exposed male threads transitioning into female NPT threads which do not have sealing sleeves, including transitions from PVC

couplings/female adapters to PVC coated GRC elbows in direct burial applications. PVC Coated Sealing Locknuts are not to be used in place of a conduit hub.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; zinc-coated steel or aluminum.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
   1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
   2. Fittings for EMT:
      a. Material: Steel or die cast.
      b. Type: compression.
   3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
   4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

K. PVC-Coated Fittings:
   1. Fittings shall be Form 8 with a V-Seal tongue-in-groove gasket and supplied with plastic encapsulated stainless steel cover screws. Form 8 fittings shall be UL Type 4X listed and IEC IP69 certified. Fittings shall be from the same manufacturer as the conduit in order to maintain system continuity and warranty. PVC Coated fittings for hazardous locations must be UL 1203 listed.

L. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
   1. CANTEX Inc.
   2. Condux International, Inc.
   3. Electri-Flex Company.
   4. Lamson & Sessions; Carlon Electrical Products.
   5. RACO; a Hubbell company.
   6. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Rigid HDPE: Comply with UL 651A.

G. Continuous HDPE: Comply with UL 651B.

H. Coilable HDPE: Preassembled with conductors or cables and complying with ASTM D 3485.

I. RTRC: Comply with UL 1684A and NEMA TC 14.

J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

K. Fittings for LFNC: Comply with UL 514B.

L. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

M. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.03 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper B-Line, Inc.
   2. Hoffman; a Pentair company.
   3. Mono-Systems, Inc.
   4. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 4, Type 12 unless otherwise indicated, and sized according to NFPA 70.
   1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type or Flanged-and-gasketed type depending on the type of space unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.04 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Allied Moulded Products, Inc.
   2. Hoffman; a Pentair company.
   3. Lamson & Sessions; Carlon Electrical Products.

B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.05 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be UL listed and labeled as defined in NFPA 70 and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect

C. Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
      a. Hubbell Wiring Systems
      b. Wiremold / Legrand.
      c. Mono-Systems, Inc.
      d. Panduit Corp.

D. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hubbell Incorporated; Wiring Device-Kellems Division.
      b. Wiremold / Legrand.
      c. Mono-Systems, Inc.
      d. Panduit Corp.

E. Tele-Power Poles:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hubbell Incorporated; Wiring Device-Kellems Division
      b. Wiremold / Legrand.Mono-Systems, Inc.
      c. Panduit Corp.
   2. Material: Galvanized steel with ivory baked-enamel finish.
   3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.06 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements.
   1. Cooper Technologies Company; Cooper Crouse-Hinds.
   2. EGS/Appleton Electric.
   3. Hoffman; a Pentair company.
   4. Hubbell Incorporated; Killark Division.
   5. O-Z/Gedney; a brand of EGS Electrical Group.
   6. RACO; a Hubbell Company.
   7. Robroy Industries.
   8. Thomas & Betts Corporation.
   9. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:
   1. Material: Cast metal.
   2. Type: Fully adjustable.
   3. Shape: Rectangular.
   4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable.
   1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
   1. Listing and Labeling: Paddle fan outlet boxes shall be NRTL listed and labeled as defined in NFPA 70, and marked for intended location and application.

J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

M. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

N. Gangable boxes are prohibited.

O. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or 4Xwith continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Nonmetallic Enclosures: Plastic.
   3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

P. Cabinets:
   1. NEMA 250, Type 1 and 4X galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.
   6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.07 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:
   1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
   2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
      a. Jensen Precast Inc.
      b. CDR Systems Corporation; Hubbell Power Systems.
      c. Oldcastle Precast, Inc.; Christy Concrete Products.
      d. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
   2. Standard: Comply with SCTE 77.
   3. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.

4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC.". Boxes containing conductors and cables over 600V, the cover shall include permanently engraved name of the utility company (e.g UCSD), type of utility (e.g. ELECTRIC), DANGER-HIGH VOLTAGE-KEEP OUT" in minimum 1/2" inch size, block letters.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
   a. CDR Systems Corporation; Hubbell Power Systems.
   b. NewBasis.
   c. Nordic Fiberglass, Inc.
   d. Oldcastle Precast, Inc.; Christy Concrete Products.
   e. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
2. Standard: Comply with SCTE 77.
3. Color of Frame and Cover: Gray.
4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, "ELECTRIC". Boxes containing conductors and cables over 600V, the cover shall include permanently engraved name of the utility company (e.g UCSD), type of utility (e.g. ELECTRIC), DANGER-HIGH VOLTAGE-KEEP OUT" in minimum 1/2" inch size, block letters.
8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.08 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: EMT. Use EPC-40PVC inside concrete walls and columns only.
3. Underground Conduit: Type EPC-40-PVC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed, Not Subject to Severe Physical Damage: EMT.
   3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
      a. Loading dock.
      b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
      c. Mechanical rooms.
      d. Gymnasiums.
   4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   5. Concealed in concrete walls and columns: Type EPC-40-PVC.
   6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   7. Damp or Wet Locations: GRC.
   8. Hazardous Area: Use fire resistant conduits RMC and fittings
   9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations, use hazardous location compatible for bulking room or any other hazardous area classified space.

C. Minimum Raceway Size: 3/4-inch trade size. 1/2-inch

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
   2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
   3. EMT: Use compression fittings. Comply with NEMA FB 2.10.
   4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F

3.02 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-footintervals.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
   3. Arrange raceways to keep a minimum of 1 inch of concrete cover in all directions.
   4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
   5. Change from ENT to RNC, Type EPC-40-PVC before rising above floor.

J. Stub-ups to Above Recessed Ceilings:
   1. Use EMT, IMC, or RMC for raceways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes with PVC touch-up compound after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly. All installers shall be certified by the manufacturer and be able to present a valid unexpired installer certification card prior to installation beginning.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 250lbs (113 kgs) tensile strength. Leave at least 12 inches of slack at each end of pull wire. Provide acrylic identification tags (2”X4”) at each end indicating the source. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:
   1. Install surface raceway with a minimum 2-inchradius control at bend points.
   2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a

blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where an underground service raceway enters a building or structure.
   3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Expansion-Joint Fittings:
   1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
   2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
      a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
      b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
      c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
      d. Attics: 135 deg F temperature change.
   3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
   4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
   5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   1. Use LFMC in damp or wet locations

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Locate boxes so that cover or plate will not span different building finishes.

CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Set metal floor boxes level and flush with finished floor surface.

FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:
   1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 20 00 "Earthwork" for pipe less than 6 inches in nominal diameter.
   2. Install backfill as specified in Section 31 20 00 "Earthwork"
   3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 20 00 "Earthwork."
   4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
   5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
      a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
      b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
   6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
   7. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances. Top of conduits inside the handhole/box shall be minimum 3 inches above the bottom of the handhole/box.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel (minimum 6 inch high), graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes with bottom below frost line, 5 inches below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.06 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 00 " Firestopping."

3.07 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. List below includes the most common products and applications for underground site distribution for electrical power and communications.

B. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct bank(s)

C. Handholes and boxes.

1.02 PULLBOXRELATED REQUIREMENTS

A. Section 26 05 26 “Grounding and Bonding of Electrical Systems.”

1.03 DEFINITION

A. RNC: Rigid nonmetallic conduit.

B. PVC coated GRS: PVC coated Galvanized rigid steel conduit

C. PVC: Poly Vinyl Chloride

D. NETA: InterNational Testing Association

1.04 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Duct-bank materials, including separators and miscellaneous components.
   2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
   3. Accessories forpullbox handholes, boxes, and other utility structures.
   4. Warning tape.
   5. Warning planks.
   6. Pull ropes.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
   1. Duct entry provisions, including locations and duct sizes.
   2. Reinforcement details.
   3. Frame and cover design and frame support rings.
   4. Ladder details.
   5. Grounding details.
   6. Cable racks, insert. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
   7. Joint details.

C. Shop Drawings for Factory-FabricatedPullbox Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
   1. Duct entry provisions, including locations and duct sizes.
   2. Cover design. Include details of factory engraved markings as specified.
   3. Grounding details.
   4. Cable racks, inserts. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.05 INFORMATIONAL SUBMITTALS

A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
   1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

2. Drawings shall be signed and sealed by a qualified California registered professional electrical engineer.

B. Product Certificates: For concrete and steel used in precast concrete pullboxpullbox and handholes, as required by ASTM C 858. Certificates shall be signed by manufacturer's structural engineer. Include name and date.

C. Qualification Data: For professional engineer and testing agency.

D. Source quality-control test reports.

E. Field quality-control test reports.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

D. Each conduit shall bear manufacturer's trademark and UL label. Conduits and fittings shall be of a single manufacturer. Multiple manufactures for the same material are not acceptable.

E. Comply with National Electric Code (NEC).

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Deliver precast concrete pullboxpullbox, handholes and other underground utility structures when the site is ready for installation. Store precast concrete and other factory-fabricated underground utility structures at project site (if necessary) as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.08 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Contracting Agency or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
   1. Notify Construction Manager and Contracting Agency no fewer than fourteen (14) days in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without Contracting Agency's written permission.
   3. Existing electrical service shall be shut down by Contracting Agency's authorized personnel. Coordinate with Contracting Agency in advance.

1.09 COORDINATION

A. Coordinate layout and installation of ducts, pullboxpullbox, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into pullboxpullbox, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to pullboxpullbox and handholes, and as approved by Architect.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of quantity of each item installed (minimum six of each type).

PART 2 PRODUCTS

2.01 CONDUIT

A. Plastic-Coated Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1. Plastic-Coated Rigid Steel Conduit and Fittings: Rigid steel conduit and fittings with an extruded polyvinyl chloride jacket, minimum 40 mils. The jacket shall have high tensile strength, shall be highly resistant to corrosion and shall not oxidize or deteriorate or shrink when exposed to sunlight and weather. The jacket shall be flame retardant and shall not support combustion. The interior of the conduit shall have a urethane coating, minimum 2 mils.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Allied Tube and Conduit
   2. Republic Conduit
   3. Western Tube

C. RNC: Heavy wall design; NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B. Make all fittings watertight with solvent-weld recommended by the conduit manufacturer and specifically manufactured for the purpose.

D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cantex, Inc.
   2. Thomas & Betts-Carlon.
   3. Lamson & Sessions -Carlon Division.
   4. JM Eagle.
   5. Allied Tube and Conduit.

2.02 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Allied Tube and Conduit.
   2. Cantex, Inc.
   3. Lamson & Sessions; Carlon Electrical Products.
   4. JM Eagle.

B. Duct Accessories:
   1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
   2. Warning Tape: Underground-line warning tape specified in Section 26 05 53 "Identification for Electrical Systems."
   3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches (300 by 600 by 76 mm) in size, manufactured from 6000-psi (41-MPa) concrete.
      a. Color: Red dye added to concrete during batching.
      b. Mark each plank with "ELECTRIC" in 2-inch- (50-mm-) high, 3/8-inch- (10-mm-) deep letters.

2.03 FLEXIBLE NONMETALLIC DUCTS

A. HDPE Duct: Type EPEC-40 HDPE, complying with NEMA TC 7 and UL 651A.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Thomas & Betts – Carlon Division.
      b. ARNCO – Dura-Line.
   2. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application

2.04 PRECAST CONCRETE HANDHOLES AND BOXES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Christy Concrete Products.
   2. Oldcastle Precast Group.

C. Comply with ASTM C 858 for design and manufacturing processes.

D. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have traffic load rating consistent with that of handhole or box.
   1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
   2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
   3. Coordinate remaining subparagraphs and associated subparagraphs below with Drawings.
   4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   5. Cover Legend: Molded lettering, ”ELECTRIC”.
   6. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
   7. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
      a. Extension shall provide increased depth of 12 inches (300 mm).
      b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
   8. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
      a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
      b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
      c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
   9. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
      a. Type and size shall match fittings to duct or conduit to be terminated.
      b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
   10. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.05 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.
   1. Color: Gray.
   2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
   3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
   4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   5. Cover Legend: Molded lettering, "ELECTRIC".

6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. Armorcast Products Company.
   b. Carson Industries LLC.
   c. CDR Systems Corporation.
   d. NewBasis.
   e. Oldcastle

C. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. Armorcast Products Company.
   b. Carson Industries LLC.
   c. Christy Concrete Products.
   d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
   e. Newbasis

D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of polymer concrete.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. Carson Industries LLC.
   b. Christy Concrete Products.
   c. Nordic Fiberglass, Inc.

E. High-Density Plastic Boxes: Injection molded of high-density polyethylene or copolymer-polypropylene. Cover shall be polymer concrete.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. Carson Industries LLC.
   b. Nordic Fiberglass, Inc.
   c. PenCell Plastics.

2.06 PRECAST PULLBOX

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Christy Concrete Products.
   2. Oldcastle Precast Group.
   3. Utility Concrete Products, LLC.
   4. Jensen Precast
   5. Utility Vault Co.

B. Comply with ASTM C 858, with structural design loading as specified in Part 3 "Underground Enclosure Application" Article and with interlocking mating sections, complete with accessories, hardware, and features.
   1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
      a. Windows shall be located no less than 6 inches (150 mm) or from interior surfaces of walls, floors, or roofs of pullboxpullbox, but close enough to corners to facilitate racking of cables on walls. Windows shall be no less than 12 inches (300 mm) from the floor to avoid water intrusion into the underground ducts.
      b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
      c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
   2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
      a. Type and size shall match fittings to duct or conduit to be terminated.
      b. Fittings shall align with elevations of approaching ducts and be located near interior corners of pullboxpullbox to facilitate racking of cable.

C. Concrete Knockout Panels: 1-1/2 to 2 inches (38 to 50 mm) thick, for future conduit entrance and sleeve for ground rod.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.07 PULLBOX UTILITY STRUCTURE ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Bilco Company (The).
   2. Christy Concrete Products.
   3. Jensen Precast.
   4. Neenah Foundry Company.
   5. Oldcastle Precast Group.
   6. Underground Devices, Inc.
   7. Utility Concrete Products, LLC.
   8. or equal.

B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B.
   a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
2. Cover Legend: Cast in. Selected to suit system.
   a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
   b. Legend: “Name of serving utility company”; "ELECTRIC-HV"; “Manhole/Handhole number as indicated on the drawings” for duct systems with medium-voltage cables.
   c. Legend: “Name of serving utility company”; "SIGNAL"; “Manhole/Handhole number as indicated on the drawings” for communications, data, and telephone duct systems.
3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
   a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. (60 L) where packaged mix complying with ASTM C 387, Type M, may be used.

C. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.

D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- (50-mm-) diameter eye, and 1-by-4-inch (25-by-100-mm) bolt.
   1. Working Load Embedded in 6-Inch (150-mm), 4000-psi (27.6-MPa) Concrete: 13,000-lbf (58-kN) minimum tension.

E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch- (32-mm-) diameter eye, rated 2500-lbf (11-kN) minimum tension.

F. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- (22-mm-) diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
   1. Ultimate Yield Strength: 40,000-lbf (180-kN) shear and 60,000-lbf (270-kN) tension.

G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch (13-mm) ID by 2-3/4 inches (69 mm) deep, flared to 1-1/4 inches (32 mm) minimum at base.
   1. Tested Ultimate Pullout Strength: 12,000 lbf (53 kN) minimum.

H. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch (13-mm) bolt, 5300-lbf (24-kN) rated pullout strength, and minimum 6800-lbf (30-kN) rated shear strength.

I. Cable Rack Assembly: Steel, hot-dip galvanized, except insulators.
   1. Stanchions: T-section or channel; 2-1/4-inch (57-mm) nominal size; punched with 14 holes on 1-1/2-inch (38-mm) centers for cable-arm attachment.
   2. Arms: 1-1/2 inches (38 mm) wide, lengths ranging from 3 inches (75 mm) with 450-lb (204-kg) minimum capacity to 18 inches (460 mm) with 250-lb (114-kg) minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
   3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

J. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
   1. Stanchions: Nominal 36 inches (900 mm) high by 4 inches (100 mm) wide, with minimum of 9 holes for arm attachment.
   2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches (75 mm) with 450-lb (204-kg) minimum capacity to 20 inch-

es (508 mm) with 250-lb (114-kg) minimum capacity. Top of arm shall be nominally 4 inches (100 mm) wide, and arm shall have slots along full length for cable ties.

K. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

L. Fixed Manhole Ladders: Arranged for attachment to roof of manhole. Ladder and mounting brackets and braces shall be fabricated from nonconductive, structural-grade, hot-dip galvanized steel. Ladder shall be removable if necessary.

M. Cover Hooks: Two required.

2.08 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of pullboxpullbox and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
   1. Tests of materials shall be performed by a independent testing agency.
   2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
   3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 EXECUTION

3.01 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-40-PVC , in concrete-encased duct bank, unless otherwise indicated.

B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

C. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

D. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

E. Bored Underground Duct: Type EPEC-40-HDPE unless otherwise indicated.

F. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40 PVC, in concrete-encased duct bank, unless otherwise indicated.

G. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, installed in concrete-encased duct bank, unless otherwise indicated.

H. Underground Ducts Crossing Roadways; loading docks and Railroads: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.02 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:
   1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
   2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
   3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.

4. Units Subject to Light-Duty Pedestrian Traffic Only: structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.

B. PullboxPullbox: Precast concrete.
   1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.

3.03 EARTHWORK

A. Excavation and Backfill: Comply with Section 31 20 00 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 32 92 00 "Turf and Grasses" and Section 32 93 00 "Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Section 01 73 29 "Cutting and Patching."

3.04 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward pullboxpullbox and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two pullboxpullbox to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 12.5 feet (4 m), both horizontally and vertically, at other locations, unless otherwise indicated. For underground ducts containing MV and HV cables, use manufactured long sweep bends with a minimum radius 25 feet (7.5 m) both horizontally and vertically. Number of bends on ducts for HV and MV systems, telephone and signal systems shall not exceed two (2) 90 degrees.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to PullboxPullbox and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.
   1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
   2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
   3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid PVC coated steel conduit at least 10 feet (3 m) outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

F. Do not install conduits underneath a building except where the service/feeder/branch circuit conduits enter the building.

G. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

H. Pulling Cord: Install minimum 1/8 inch thick test nylon cord with minimum 250 pounds per foot tensile strength in ducts, including spares.

I. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concreting Sequence: Pour each run of envelope between pullboxpullbox or other terminations in one continuous operation.
   a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
   b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
4. Encase all feeder ducts in a 3 inch concrete envelope. Extend envelope with 3 inches beyond all external surfaces of all outer most ducts. Do not over pour the concrete.
5. Concrete encasement shall be minimum 3000 psi. All underground ducts containing MV and HV cables (above 600V) shall be encased in red concrete. Concrete shall be premixed during batching with 1-1/2 lbs of red ocher dye per sack of cement.
6. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
7. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
8. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, and 12 inches (300 mm) between power and signal ducts.
9. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated. Minimum depth below grade in all areas shall be 36 inches (900 mm) for underground ducts containing MV and HV ducts.
10. Stub-Ups: Use manufactured PVC coated rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    a. Couple PVC coated steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
11. Warning Tape: Bury warning tape approximately 12 inches (300 mm) below grade above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

J. Direct-Buried Duct Banks:
   1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
   2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to pre-

vent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.

3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 31 20 00 "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
4. Install backfill as specified in Section 31 20 00 "Earthwork"
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Section 31 20 00 "Earth Moving."
6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 12 inches (300 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured PVC coated rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    a. Couple PVC coated steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. For equipment mounted on outdoor concrete bases, extend PVC coated steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
11. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried ducts and duct banks, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional planks 12 inches (300 mm) apart, horizontally.

3.05 INSTALLATION OF CONCRETE PULLBOX, HANDHOLES, AND BOXES

A. Precast Concrete Handhole and pullbox Installation:
   1. Comply with ASTM C 891, unless otherwise indicated.
   2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
   3. Unless otherwise indicated, support units on a level bed of 12 inches thick crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:
   1. Install handholes with bottom below the frost line, 10ft below grade.
   2. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
   3. Where indicated, cast handhole cover frame integrally with handhole structure.

C. Drainage: Install drains in bottom of pullbox where indicated. Coordinate with drainage provisions indicated.

D. Manhole Access: Circular opening in manhole roof; sized to match cover size.
   1. Pullbox with Fixed Ladders: Offset access opening from pullbox centerlines to align with ladder.

2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with pullbox roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

E. Waterproofing: Apply waterproofing to exterior surfaces of pullboxpullbox and handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Section 07 14 00"Thermoplastic Sheet Waterproofing." After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of pullbox chimneys after mortar has cured at least three days.

F. Dampproofing: Apply dampproofing to exterior surfaces of pullboxpullbox and handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Section 07 11 13 "Bituminous Dampproofing." After ducts have been connected and grouted, and before backfilling, dampproof joints and connections and touch up abrasions and scars. Dampproof exterior of pullbox chimneys after mortar has cured at least three days.

G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

H. Fixed Pullbox Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in pullboxpullbox.

I. Field-Installed Bolting Anchors in PullboxPullbox and Concrete Handholes: Do not drill deeper than 3-7/8 inches (98 mm) for pullboxpullbox and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

J. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each pullbox cover.

3.06 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of 12 inches thick crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line, 5 inches below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth .

1. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep) .

3.07 GROUNDING

A. Ground underground ducts and utility structures according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.08 FIELD QUALITY CONTROL

A. During construction, partially completed duct lines shall be protected from the entrance of debris such as mud, sand and dirt by means of suitable conduit plugs. As each section of a duct line is completed from pullbox to vault, a testing mandrel not less than 12 inches long with a diameter 1/4-inch less than the size of the duct, shall be drawn through each duct, after which a brush having the diameter of the duct, and have stiff bristles shall be drawn through until the conduit is clear of all particles of earth, sand, gravel and other foreign materials. Conduit plugs shall then be immediately installed. Underground conduits, which terminate inside the building below grade, or which slope so that water might flow into building, shall be sealed at termination after installation of wires.

B. Perform the following tests and inspections and prepare test reports:
   1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
   2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
   3. Test pullbox and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Correct deficiencies and retest as specified above to demonstrate compliance.

3.09 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of pullbox, including sump. Remove foreign material.

END OF SECTION 26 05 43

This page intentionally left blank

SECTION 26 05 44

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.

B. Sleeve-seal systems.

C. Sleeve-seal fittings.

D. Grout.

E. Silicone sealants.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 " Firestopping" for firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:
   1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
   2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 2 PRODUCTS

2.01 SLEEVES

A. Wall Sleeves:
   1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
   2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:
   1. Material: Galvanized sheet steel.
   2. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
      b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.02 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers
      a. Advance Products & Systems, Inc.
      b. CALPICO, Inc.
      c. Metraflex Company (The).
      d. Pipeline Seal and Insulator, Inc.
      e. Proco Products, Inc.
      f. 3M.
   2. Sealing Elements: Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   3. Pressure Plates: Carbon steel.
   4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.03 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers
      a. Presealed Systems.
      b. Metraflex.

2.04 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.05 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
   2. Sealant shall have VOC content of 60 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 EXECUTION

3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 "Joint Sealants."
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
   5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
   2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install PVC Coated cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44

This page intentionally left blank

SECTION 26 05 48

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

1.02 SECTION INCLUDES

A. Isolation pads.

B. Spring isolators.

C. Restrained spring isolators.

D. Channel support systems.

E. Restraint cables.

F. Hanger rod stiffeners.

G. Anchorage bushings and washers.

1.03 RELATED REQUIREMENTS

A. Section 26 05 29 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.04 RELATED DOCUMENTS

A. Section 26 00 00 “General Electrical Requirements.”

1.05 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.06 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
   1. Site Class as Defined in the IBC: D.
   2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.
      a. Component Importance Factor: 1.0.
      b. Component Response Modification Factor: See Drawing S0.1 for Criteria..
      c. Component Amplification Factor: See Drawing S0.1 for Criteria .
   3. Design Spectral Response Acceleration at Short Periods (0.2 Second): See Drawing S0.1 for Criteria
   4. Design Spectral Response Acceleration at 1.0-Second Period: See Drawing S0.1 for Criteria

1.07 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated byan agency acceptable to authorities having jurisdiction.
      b. Annotate to indicate application of each product submitted and compliance with requirements.
   3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
      a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other electrical Sections for equipment mounted outdoors.
   2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
   3. Field-fabricated supports.
   4. Seismic-Restraint Details:
      a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
      b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
      c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.08 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Field quality-control test reports.

1.09 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   1. Ace Mountings Co., Inc.
   2. Amber/Booth Company, Inc.
   3. California Dynamics Corporation.
   4. Isolation Technology, Inc.
   5. Kinetics Noise Control.
   6. Mason Industries.
   7. Vibration Eliminator Co., Inc.
   8. Vibration Isolation.
   9. Vibration Mountings & Controls, Inc.

D. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
   1. Resilient Material: Oil- and water-resistant neoprene, rubber or hermetically sealed compressed fiberglass.

E. Spring Isolators Freestanding, laterally stable, open-spring isolators.
   1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
   6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
   1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
   2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
   3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.02 SEISMIC-RESTRAINT DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawingsor a comparable product by one of the following:
   1. Amber/Booth Company, Inc.
   2. California Dynamics Corporation.
   3. Cooper B-Line, Inc.; a division of Cooper Industries.

4. Hilti Inc.
5. Loos & Co.; Seismic Earthquake Division.
6. Mason Industries.
7. TOLCO Incorporated; a brand of NIBCO INC.
8. Unistrut; Tyco International, Ltd.

D. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an evaluation service member of ICC-ES oror an agency acceptable to authorities having jurisdiction.
   1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

E. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

F. Restraint Cables: ASTM A 603 galvanized or ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

G. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections orReinforcing steel angle clamped to hanger rod. Do not weld stiffeners to rods.

H. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

K. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

L. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.03 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
   1. Powder coating on springs and housings.
   2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
   3. Baked enamel or powder coat for metal components on isolators for interior use.
   4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:
   1. Install restrained isolators on electrical equipm ent.
   2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
   3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer's recommended torque, using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least fourof each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.06 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 26 05 48

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Color and legend requirements for raceways, conductors, and warning labels and signs.

B. Labels.

C. Bands and tubes.

D. Tapes and stencils.

E. Tags.

F. Signs.

G. Cable ties.

H. Paint for identification.

I. Fasteners for labels and signs.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E and Section 26 05 73 "Short Circuit, Coordination and Arc-Flash Study" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:
   1. Black letters on an orange field.
   2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service' feeder and branch-circuit conductors.
   1. Color shall be factory applied.
   2. Colors for 208/120-V Circuits:
      a. Phase A: Black.
      b. Phase B: Red.

c. Phase C: Blue.
3. Colors for 240-V Circuits:
a. Phase A: Black.
b. Phase B: Red.
4. Colors for 480/277-V Circuits:
a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.
5. Color for Neutral: White.
6. Color for Equipment Grounds: Green.
7. Colors for Isolated Grounds: Green with white stripe.

C. Raceways and Cables Carrying Circuits at More Than 600 V:
1. Black letters on an orange field.
2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:
1. Identify system voltage with black letters on an orange background.

E. Warning labels and signs shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

F. Equipment Identification Labels:
1. Black letters on a white field for equipment connected to normal power and Red letters on a white field for equipment connected to emergency/standby power unless otherwise indicated.

2.03 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Brady Corporation.
b. HellermannTyton.
c. Marking Services, Inc.
d. Panduit Corp.
e. Seton Identification Products.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Brady Corporation.
b. HellermannTyton.
c. Marking Services, Inc.
d. Panduit Corp.
e. Seton Identification Products.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, polyesterflexible label with acrylic pressure-sensitive adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Brady Corporation.
b. Grafoplast Wire Markers.
c. Ideal Industries, Inc.
d. Marking Services, Inc.

e. Panduit Corp.
f. Seton Identification Products.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
3. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Brady Corporation.
b. Grafoplast Wire Markers.
c. HellermannTyton.
d. Ideal Industries, Inc.
e. Marking Services, Inc.
f. Panduit Corp.
g. Seton Identification Products.
2. Minimum Nominal Size:
a. 1-1/2 by 6 inches for raceway and conductors.
b. 3-1/2 by 5 inches for equipment.
c. As required by authorities having jurisdiction.

2.04 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Brady Corporation.
b. HellermannTyton.
c. Marking Services, Inc.
d. Panduit Corp.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Brady Corporation.
b. Panduit Corp.

2.05 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Carlton Industries, LP.
b. HellermannTyton.
c. Ideal Industries, Inc.
d. Marking Services, Inc.
e. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brady Corporation.
      b. Carlton Industries, LP.
      c. emedco.
      d. Marking Services, Inc.

C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. HellermannTyton.
      b. LEM Products Inc.
      c. Marking Services, Inc.
      d. Seton Identification Products.

D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Carlton Industries, LP.
      b. Seton Identification Products.

E. Underground-Line Warning Tape:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brady Corporation.
      b. Ideal Industries, Inc.
      c. Marking Services, Inc.
      d. Seton Identification Products.
   2. Tape:
      a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
      b. Printing on tape shall be permanent and shall not be damaged by burial operations.
      c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
   3. Color and Printing:
      a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
      b. Inscriptions for Red-Colored Tapes: "CAUTION BURIED ELECTRIC LINE, HIGH VOLTAGE" .
      c. Inscriptions for Orange-Colored Tapes: "CAUTION BURIED TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE" .
   4. Tag: Type IID:
      a. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
      b. Width: 6 inches.
      c. Overall Thickness: 5 mils.
      d. Foil Core Thickness: 0.35 mil.
      e. Weight: 34 lb/1000 sq. ft..
      f. Tensile according to ASTM D 882: 300 lbf and 12,500 psi.

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be inchunless otherwise indicated. If requested by Architect, match Contracting Agency's existing legend type, size etc.

2.06 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brady Corporation.
      b. Carlton Industries, LP.
      c. emedco.
      d. Marking Services, Inc.
      e. Seton Identification Products.

2.07 SIGNS

A. Baked-Enamel Signs:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Carlton Industries, LP.
      b. Champion America.
      c. emedco.
      d. Marking Services, Inc.
   2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
   3. 1/4-inch grommets in corners for mounting.
   4. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brady Corporation.
      b. Champion America.
      c. emedco.
      d. Marking Services, Inc.
   2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
   3. 1/4-inch grommets in corners for mounting.
   4. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brady Corporation.
      b. Carlton Industries, LP.
      c. emedco.
      d. Marking Services, Inc.
   2. Engraved legend.
   3. Thickness:
      a. For signs up to 20 sq. in., minimum 1/16 inch thick.
      b. For signs larger than 20 sq. in., 1/8 inch thick.
      c. Engraved legend with black letters on white face background for equipment connected to normal power and red letters on white face background for equipment connected to emergency/standby power. Verify with Architect if legend has to match Contracting Agency's existing signs.

d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.08 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. HellermannTyton.
2. Ideal Industries, Inc.
3. Marking Services, Inc.
4. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.09 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.01 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.02 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer. Refer to drawings for additional information.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
   1. "EMERGENCY POWER."
   2. "POWER."
   3. "UPS."

M. Vinyl Wraparound Labels:
   1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
   2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Labels:
   1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
   1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

W. Underground Line Warning Tape:
   1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
   2. Limit use of underground-line warning tape to direct-buried cables.
   3. Install underground-line warning tape for direct-buried cables and cables in raceways.

X. Metal Tags:
   1. Place in a location with high visibility and accessibility.
   2. Secure using general-purpose UV-stabilized cable ties for all area except use plenum-rated cable ties in plenum areas.

Y. Nonmetallic Preprinted Tags:
   1. Place in a location with high visibility and accessibility.
   2. Secure using general-purpose UV-stabilized in all areas except use plenum-rated cable ties in plenum areas.

Z. Baked-Enamel Signs:
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

AA. Metal-Backed Butyrate Signs:
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

BB. Laminated Acrylic or Melamine Plastic Signs:
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

CC. Cable Ties: General purpose, for attaching tags, except as listed below:
   1. Outdoors: UV-stabilized nylon.
   2. In Spaces Handling Environmental Air: Plenum rated.

3.03 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch-high, black letters on 20-inch centers.
   1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10-foot maximum intervals unless otherwise indicated.

D. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

E. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

F. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels to identify the phase.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.

H. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

I. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.

J. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

K. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

L. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

M. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
   1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
   2. Wall surfaces directly external to raceways concealed within wall.
   3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

N. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

O. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

P. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Metal-backed, butyrate warning signs.
   1. Apply to exterior of door, cover, or other access.
   2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
      a. Power-transfer switches.
      b. Controls with external control power connections.

Q. Arc Flash Warning Labeling: Self-adhesive labels.

R. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.

S. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

T. Equipment Identification Labels:
   1. Indoor Equipment: Laminated acrylic or melamine plastic sign.

2. Outdoor Equipment: Laminated acrylic or melamine sign. Stenciled legend 4 inches high shall also be provided when requested by Architect.
3. Equipment to Be Labeled:
    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.
    b. Enclosures and electrical cabinets.
    c. Access doors and panels for concealed electrical items.
    d. Switchgear.
    e. Switchboards.
    f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    g. Substations.
    h. Emergency system boxes and enclosures.
    i. Motor-control centers.
    j. Enclosed switches.
    k. Enclosed circuit breakers.
    l. Enclosed controllers.
    m. Variable-speed controllers.
    n. Push-button stations.
    o. Power-transfer equipment.
    p. Contactors.
    q. Remote-controlled switches, dimmer modules, and control devices.
    r. Battery-inverter units.
    s. Battery racks.
    t. Power-generating units.
    u. Monitoring and control equipment.
    v. UPS equipment.

END OF SECTION 26 05 53

SECTION 26 05 73

SHORT CIRCUIT, COORDINATION AND ARC FLASH STUDIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Computer-based, fault-current, overcurrent protective device coordination studies and arc flash study. Protective devices shall be set based on results of the protective device coordination study.
   1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.02 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.

B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

E. Power System Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.

G. SCCR: Short-circuit current rating.

H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

I. Single-Line Diagram: See "One-Line Diagram."

1.03 ACTION SUBMITTALS

A. Coordination Studies
   1. Product Data: For computer software program to be used for studies.
   2. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals may be in digital form if requested by the architect/engineer.
   3. Coordination-study input data, including completed computer program input data sheets.
   4. Study and Equipment Evaluation Reports.
   5. Coordination-Study Report.

B. Short Curcuit Studies
   1. For computer software program to be used for studies.
   2. Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.
      a. Short-circuit study input data, including completed computer program input data sheets.
      b. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
      c. Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

C. Arc Flash Studies
   1. Product Data: For computer software program to be used for studies.
   2. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals may be in digital form:
   3. Arc-flash study input data, including completed computer program input data sheets.
   4. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For power systems analysis specialist.

B. Product Certificates: For coordination-study, fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

D. Power Systems Analysis Software Developer

E. Qualification Data: For Field Adjusting Agency

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
   1. The following are from the Coordination Study Report:
      a. Final one-line diagram.
      b. Final protective device coordination study.
      c. Coordination study data files.
      d. List of all protective device settings.
      e. Time-current coordination curves.
      f. Power system data.
   2. The following are from the Short-Circuit Study Report:
      a. Final one-line diagram.
      b. Final Short-Circuit Study Report.
      c. Short-circuit study data files.
      d. Power system data
   3. The following are from the Arc Flash Hazard Report:
      a. Provide maintenance procedures in equipment manuals according to requirements in NFPA 70E.
      b. Operation and Maintenance Procedures: In addition to items specified in Section 1-11 "Operation and Maintenance Data," provide maintenance procedures for use by Contracting Agency's personnel that comply with requirements in NFPA 70E.

1.06 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Power Systems Analysis Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
   1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

E. Field Adjusting Agency Qualifications:
   1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.

2. A member company of NETA.
3. Acceptable to authorities having jurisdiction

PART 2 PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:

B. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Operation Technology, Inc. (ETAP)
2. SKM Systems Analysis, Inc.(Power Tools)

2.02 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399, IEEE 1584 and NFPA 70E.

B. Analytical features of fault-current-study, device coordination study and arc flash study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
1. Optional Features:
   a. Arcing faults.
   b. Simultaneous faults.
   c. Explicit negative sequence.
   d. Mutual coupling in zero sequence.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.02 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:
1. Product Data for overcurrent protective devices specified in other electrical Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
   a. Circuit-breaker and fuse-current ratings and types.
   b. Relays and associated power and current transformer ratings and ratios.
   c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
   d. Generator kilovolt amperes, size, voltage, and source impedance.

e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
f. Busway ampacity and impedance.
g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
   a. Special load considerations, including starting inrush currents and frequent starting and stopping.
   b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
   c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
   d. Generator thermal-damage curve.
   e. Ratings, types, and settings of utility company's overcurrent protective devices.
   f. Special overcurrent protective device settings or types stipulated by utility company.
   g. Time-current-characteristic curves of devices indicated to be coordinated.
   h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
   i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
   j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.03 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
   1. Switchgear and switchboard bus.
   2. Medium-voltage controller.
   3. Motor-control center.
   4. Distribution panelboard.
   5. Branch circuit panelboard.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current according to IEEE 551.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 and IEEE 242.
   1. Transformers:
      a. ANSI C57.12.10.
      b. ANSI C57.12.22.
      c. ANSI C57.12.40.
      d. IEEE C57.12.00.
      e. IEEE C57.96.
   2. Medium-Voltage Circuit Breakers: IEEE C37.010.
   3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
   4. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

F. Equipment Evaluation Report:
1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.04 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 241 recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:
1. Device shall not operate in response to the following:
a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
a. Device tag.
b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
d. Fuse-current rating and type.
e. Ground-fault relay-pickup and time-delay settings.
2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
a. Device tag.
b. Voltage and current ratio for curves.
c. Three-phase and single-phase damage points for each transformer.

d. No damage, melting, and clearing curves for fuses.
e. Cable damage curves.
f. Transformer inrush points.
g. Maximum fault-current cutoff point.

G. Completed data sheets for setting of overcurrent protective devices.

3.05 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination study prior to starting the Arc-Flash Hazard Analysis.
1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 05 73. "Short-Circuit Studies."
2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 26 05 73. "Coordination Studies."

C. Calculate maximum and minimum contributions of fault-current size.
1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
2. Calculate arc-flash energy at the recommended short circuit values according to IEEE 1584.section 4.5.
3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.
4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.

D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

E. Include medium-and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.

F. Calculate the limited, restricted, and prohibited approach boundaries for each location.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section 6.9.

3.06 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 05 73 "Short-Circuit Studies."

F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 26 05 73"Coordination Studies."

G. Arc-Flash Study Output Reports:
1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:
a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:
1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Restricted approach boundary.
6. Limited approach boundary.
7. Working distance.
8. Incident energy.
9. Hazard risk category.
10. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

3.07 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.

B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
1. Location designation.
2. Nominal voltage.
3. Protection boundaries.
a. Arc-flash boundary.
b. Restricted approach boundary.
c. Limited approach boundary.
4. Arc flash PPE category.
5. Required minimum arc rating of PPE in Cal/cm squared.
6. Available incident energy.

7. Working distance.
8. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

D. Apply a label to each piece of equipment addresses by the study.

END OF SECTION 26 05 73

SECTION 26 09 13

ELECTRICAL POWER MONITORING AND CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The following for monitoring and control of electrical power system:
   1. PC-based workstation(s) and software.
   2. Communication network and interface modules for RS-485, Modbus TCP/IP data transmission protocols.

1.02 RELATED REQUIREMENTS

A. Section 26 27 13 "Electricity Metering" for equipment to meter electricity consumption and demand for tenant submetering.

1.03 DEFINITIONS

A. Ethernet: Local area network based on IEEE 802.3 standards.

B. Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.

C. HTML: Hypertext markup language.

D. I/O: Input/output.

E. KY Pulse: A term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay changing status in response to the rotation of the disk in the meter.

F. LAN: Local area network; sometimes plural as "LANs."

G. LCD: Liquid crystal display.

H. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or remote-control, signaling and power-limited circuits.

I. Modbus TCP/IP: An open protocol for exchange of process data.

J. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

K. PC: Personal computer; sometimes plural as "PCs."

L. rms: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

M. RS-232: A TIA standard for asynchronous serial data communications between terminal devices.

N. RS-485: A TIA standard for multipoint communications using two twisted-pairs.

O. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

P. THD: Total harmonic distortion.

Q. UPS: Uninterruptible power supply; used both in singular and plural context.

R. WAN: Wide area network.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Attach copies of approved Product Data submittals for products (such as switchboards and switchgear) that describe power monitoring and control features to illustrate coordination among related equipment and power monitoring and control.

B. Shop Drawings: For power monitoring and control equipment. Include plans, elevations, sections, details, and attachments to other work.
   1. Outline Drawings: Indicate arrangement of components and clearance and access requirements.
   2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
   3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   4. Wiring Diagrams: For power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
   5. UPS sizing calculations for workstation.
   6. Surge Suppressors: Data for each device used and where applied.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified manufacturer.

B. Field quality-control reports.

C. Other Informational Submittals:
   1. Manufacturer's system installation and setup guides, with data forms to plan and record options and setup decisions.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power monitoring and control units, to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 1-11 "Operation and Maintenance Data," include the following:
   1. Operating and applications software documentation.
   2. Software licenses.
   3. Software service agreement.
   4. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.
   5. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.

B. Software and Firmware Operational Documentation:
   1. Self-study guide describing the process for setting equipment's network address; setting Contracting Agency's options; procedures to ensure data access from any PC on the network, using a standard Web browser; and recommended firewall setup.
   2. Software operating and upgrade manuals.
   3. Software Backup: On a magnetic media or compact disc, complete with Contracting Agency-selected options.
   4. Device address list and the set point of each device and operator option, as set in applications software.
   5. Graphic file and print out of graphic screens and related icons, with legend.

C. Software Upgrade Kit: For Contracting Agency to use in modifying software to suit future power system revisions or power monitoring and control revisions.

D. Software licenses and upgrades required by and installed for operating and programming digital and analog devices.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Addressable Relays: One for every 10 installed. Furnish at least one of each type.

2. Data Line Surge Suppressors: One for every 10 of each type installed. Furnish at least one of each type.
3. I/O Protection Fuses: One for every 10 of each type installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Manufacturer Qualifications: A firm experienced in manufacturing power monitoring and control equipment similar to that indicated for this Project and with a record of successful in-service performance.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.09 COORDINATION

A. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.
1. Match components and interconnections for optimum performance of specified functions.

B. Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

1.10 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for 2 years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within 2 years from date of Substantial Completion. Upgrading software shall include the operating systems. Upgrade shall include new or revised licenses for use of software.
1. Provide 30 days' notice to Contracting Agency to allow scheduling and access to system and to allow Contracting Agency to upgrade computer equipment if necessary.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Corporation; Cutler-Hammer products.
2. General Electric Company; GE Consumer & Industrial.
3. Landis+Gyr Inc.
4. Rockwell Automation, Inc.; Allen-Bradley brand.
5. Schneider Electric - Power Management Operation.

2.02 FUNCTIONAL DESCRIPTION

A. Instrumentation and Recording Devices: Monitor and record load profiles and chart energy consumption patterns.
1. Calculate and Record the Following:
a. Load factor.
b. Peak demand periods.
2. Measure and Record Metering Data for the Following:
a. Electricity.
b. Domestic water.
c. Natural gas.

B. Software: Calculate allocation of utility costs.
1. Automatically Import Energy Usage Records to Allocate Energy Costs for the Following:
a. At least 15 departments.

b. At least 30 tenants.
c. At least five buildings.

C. Power Quality Monitoring: Identify power system anomalies and measure, display, and record trends and alarms of the following power quality parameters:
1. Voltage regulation and unbalance.
2. Continuous three-phase rms voltage.
3. Periodic max./min./avg. voltage samples.
4. Harmonics.
5. Voltage excursions.

D. Emergency Load Shedding. Preserve critical loads or avoid total shutdown due to unforeseen loss of power sources according to the following logic:
1. Determine system topology.
2. Evaluate remaining loads and sources.
3. Shed loads in less than 100 ms.

E. Demand Management:
1. Peaking or co-generator control.
2. Load interlocking.
3. Load shedding.
4. Load trimming.

F. System: Report equipment status and power system control.

2.03 SYSTEM REQUIREMENTS

A. Monitoring and Control System: Include multiple PC-based workstations, with its operating system and application software, connected to data transmission network.

B. Surge Protection: For external wiring of each conductor entry connection to components to protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads.
1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Section 26 43 13 "Surge Protection for Low-Voltage Electrical Power Circuits."
2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements as recommended by manufacturer for type of line being protected.

C. Addressable Devices: All transmitters and receivers shall communicate unique device identification and status reports to monitoring and control clients.

D. DDC Interface: Provide factory-installed hardware and software to enable the DDC to monitor, display, and record data for use in processing reports.
1. Hardwired Monitoring Points: Electrical power demand (kilowatts), electrical power consumption (kilowatt-hours), power factor.
2. ASHRAE 135 (BACnet) communication interface with the DDC shall enable the DDC operator to remotely monitor meter information from a DDC operator workstation. Control features and monitoring points displayed locally at metering panel shall be available through the DDC BAS.

2.04 OPERATING SYSTEM

A. Software: Configured to run on a portable laptop computer, a single PC, or a tablet computer, with capability for accessing a single meter at a time. System is not connected to a LAN. Modbus TCP/IP, RS-232, and RS-485 digital communications.

B. Software: Configured to run on a single PC, with capability for accessing multiple devices simultaneously. Modbus TCP/IP, RS-232, and RS-485 digital communications.

C. Software: Configured for a server and multiple client PCs, each with capability for accessing multiple devices simultaneously. Ethernet, Modbus TCP/IP, RS-232, and RS-485 digital communications.

D. Software: Configured for a server and multiple client PCs, each with capability for accessing multiple devices simultaneously. Software shall include interactive graphics client and shall be Web enabled. Workstations and portable computers shall not require any software except for an Internet browser to provide connectivity and full functionality. Include a firewall recommended by manufacturer. 100 Base-T Ethernet, Modbus TCP/IP RS-232, and RS-485 digital communications.

E. Operating System Software: Based on 32-bit, Microsoft Windows workstation operating system. Software shall have the following features:
   1. Multiuser and multitasking to allow independent activities and monitoring to occur simultaneously at different workstations.
   2. Graphical user interface to show pull-down menus and a menu tree format.
   3. Capability for future additions within the indicated system size limits.

F. Peer Computer Control Software: Shall detect a failure of workstation to assume control of all system functions without interruption of operation. Drivers shall be provided in both central computers to support this mode of operation.

2.05 APPLICATIONS SOFTWARE

A. Basic Requirements:
   1. Fully compatible with and based on the approved operating system.
   2. Password-protected operator login and access; three levels, minimum.
   3. Password-protected setup functions.
   4. Context-sensitive online help.
   5. Capability of creating, deleting, and copying files; and automatically maintaining a directory of all files, including size and location of each sequential and random-ordered record.
   6. Capability for importing custom icons into graphic views to represent alarms and I/O devices.
   7. Automatic and encrypted backups for database and history; automatically stored at central control PC and encrypted with a nine-character alphanumeric password, which must be used to restore or read data contained in backup.
   8. Operator audit trail for recording and reporting all changes made to user-defined system options.

B. Workstation Server Functions:
   1. Support other client PCs on the LAN.
   2. Maintain recorded data in databases accessible from other PCs on the LAN.

C. Data Formats:
   1. User-programmable export and import of data to and from commonly used Microsoft Windows spreadsheet, database, billing, and other applications; using dynamic data exchange technology.
   2. Option to convert reports and graphics to HTML format.
   3. Interactive graphics.
   4. Option to send preprogrammed or operator designed e-mail reports.

D. Metered Data: Display metered values in real time.

E. Remote Control:
   1. Display circuit-breaker status and allow breaker control.
   2. User defined with load-shedding automatically initiated and executed schemes responding to programmed time schedules, set points of metered demands, utility contracted load shedding, or combinations of these.

F. Equipment Documentation: Database for recording of equipment ratings and characteristics; with capability for graphic display on monitors.

G. Graphics: Interactive color-graphics platform with pull-down menus and mouse-driven generation of power system graphics, in formats widely used for such drafting; to include the following:
   1. Site plan.
   2. Floor plans.
   3. Equipment elevations.
   4. Single-line diagrams.

H. User-Defined Monitoring and Control Events: Display and record with date and time stamps accurate to 0.1 second, and including the following:
   1. Operator log on/off.
   2. Attempted operator log on/off.
   3. All alarms.
   4. Equipment operation counters.
   5. Out-of-limit, pickup, trip, and no-response events.

I. Trending Reports: Display data acquired in real-time from different meters or devices, in historical format over user-defined time; unlimited as to interval, duration, or quantity of trends.
   1. Spreadsheet functions of sum, delta, percent, average, mean, standard deviation, and related functions applied to recorded data.
   2. Charting, statistical, and display functions of standard Windows-based spreadsheet.

J. Alarms: Display and record alarm messages from discrete input and controls outputs, according to user programmable protocol.
   1. Functions requiring user acknowledgment shall run in background during computer use for other applications and override other presentations when they occur.

K. Waveform Data: Display and record waveforms on demand or automatically on an alarm or programmed event. Include the graphic displays of the following, based on user-specified criteria:
   1. Phase voltages, phase currents, and residual current.
   2. Overlay of three-phase currents and overlay each phase voltage and current.
   3. Waveforms ranging in length from 2 cycles to 5 minutes.
   4. Disturbance and steady-state waveforms up to 512 points per cycle.
   5. Transient waveforms up to 83,333 points per cycle on 60-Hz base.
   6. Calculated waveform, based on recorded data, on a minimum of four cycles of data of the following:
      a. THD.
      b. rms magnitudes.
      c. Peak values.
      d. Crest factors.
      e. Magnitude of individual harmonics.

L. Data Sharing: Allow export of recorded displays and tabular data to third-party applications software.
   1. Tabular data shall be in the comma-separated values.

M. Activity Billing Software:
   1. Automatically compute and prepare activity demand and energy-use statements based on metering of energy use and peak demand integrated over user-defined interval.
   2. Intervals shall be same as used by electric utilities, including current vendor.
   3. Import metered data from saved records that were generated by metering and monitoring software.
   4. Maintain separate directory for each activity's historical billing information.
   5. Prepare summary reports in user-defined formats and time intervals.

N. Reporting: User commands initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.
   1. Print a record of user-defined alarm, supervisory, and trouble events on workstation printer.

2. Sort and report by device name and by function.
3. Report type of signal (alarm, supervisory, or trouble), description, date, and time of occurrence.
4. Differentiate alarm signals from other indications.
5. When system is reset, report reset event with same information concerning device, location, date, and time.

O. Display Monitor:
1. Backlighted LCD to display metered data with touch-screen selecting device.
2. Touch-screen display shall be a minimum 12-inch diagonal, resolution of 800 by 600 RGB pixels, 256 colors; NEMA 250, Type 1 display enclosure.
3. Display 4 values on one screen at same time.

2.06 COMMUNICATION COMPONENTS AND NETWORKS

A. Network Configuration: High-speed, multi-access, open nonproprietary, industry standard communication protocol; LANs complying with EIA 485, 100 Base-T Ethernet, and Modbus TCP/IP.

2.07 POWER MONITORS

A. Separately mounted, permanently installed instrument for power monitoring and control, complying with UL 1244.
1. Enclosure: NEMA 250, Type 1

B. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
1. Indoor installation in non-air-conditioned spaces that have environmental controls to maintain ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.

C. rms Real-Time Measurements:
1. Current: Each phase, neutral, average of three phases, percent unbalance.
2. Voltage: Line-to-line each phase, line-to-line average of three phases, line-to-neutral each phase, line-to-neutral average of three phases, line-to-neutral percent unbalance.
3. Power: Per phase and three-phase total.
4. Reactive Power: Per phase and three-phase total.
5. Apparent Power: Per phase and three-phase total.
6. Power Factor: Per phase and three-phase total.
7. Displacement Power Factor: Per phase and three-phase total.
8. Frequency.
9. THD: Current and voltage.
10. Accumulated Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
11. Incremental Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
12. Conditional Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).

D. Demand Current Calculations, per Phase, Three-Phase Average and Neutral:
1. Present.
2. Running average.
3. Last completed interval.
4. Peak.

E. Demand Real Power Calculations, Three-Phase Total:
1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.

7. Coincident with kVAR demand.

F. Demand Reactive Power Calculations, Three-Phase Total:
1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

G. Demand Apparent Power Calculations, Three-Phase Total:
1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

H. Average Power Factor Calculations, Demand Coincident, Three-Phase Total:
1. Last completed interval.
2. Coincident with kW peak.
3. Coincident with kVAR peak.
4. Coincident with kVA peak.

I. Power Analysis Values:
1. THD, Voltage and Current: Per phase, three phase, and neutral.
2. Displacement Power Factor: Per phase, three phase.
3. Fundamental Voltage, Magnitude and Angle: Per phase.
4. Fundamental Currents, Magnitude and Angle: Per phase.
5. Fundamental Real Power: Per phase, three phase.
6. Fundamental Reactive Power: Per phase.
7. Harmonic Power: Per phase, three phase.
8. Phase rotation.
9. Unbalance: Current and voltage.
10. Harmonic Magnitudes and Angles for Current and Voltages: Per phase, up to 31st harmonic.

J. Power Demand Calculations: According to one of the following calculation methods, selectable by the user:
1. Thermal Demand: Sliding window updated every second for the present demand and at end of the interval for the last interval. Adjustable window that can be set in 1-minute intervals, from 1 to 60 minutes.
2. Block Interval with Optional Subintervals: Adjustable for 1-minute intervals, from 1 to 60 minutes. User-defined parameters for the following block intervals:
   a. Sliding block that calculates demand every second, with intervals less than 15 minutes, and every 15 seconds with an interval between 15 and 60 minutes.
   b. Fixed block that calculates demand at end of the interval.
   c. Rolling block subinterval that calculates demand at end of each subinterval and displays it at end of the interval.
3. Demand Calculation Initiated by a Synchronization Signal:
   a. Signal is a pulse from an external source. Demand period begins with every pulse. Calculation shall be configurable as either a block or rolling block calculation.
   b. Signal is a communication signal. Calculation shall be configurable as either a block or rolling block calculation.
   c. Demand can be synchronized with clock in the power meter.

K. Sampling:
   1. Current and voltage shall be digitally sampled at a rate high enough to provide accuracy to 63rd harmonic of 60-Hz fundamental.
   2. Power monitor shall provide continuous sampling at a rate of 128 samples per cycle on all voltage and current channels in the meter.

L. Minimum and Maximum Values: Record monthly minimum and maximum values, including date and time of record. For three-phase measurements, identify phase of recorded value. Record the following parameters:
   1. Line-to-line voltage.
   2. Line-to-neutral voltage.
   3. Current per phase.
   4. Line-to-line voltage unbalance.
   5. Line-to-neutral voltage unbalance.
   6. Power factor.
   7. Displacement power factor.
   8. Total power.
   9. Total reactive power.
   10. Total apparent power.
   11. THD voltage L-L.
   12. THD voltage L-N.
   13. THD current.
   14. Frequency.

M. Harmonic Calculation: Display and record the following:
   1. Harmonic magnitudes and angles for each phase voltage and current through 31st harmonic. Calculate for all three phases, current and voltage, and residual current. Current and voltage information for all phases shall be obtained simultaneously from same cycle.
   2. Harmonic magnitude reported as a percentage of the fundamental or as a percentage of rms values, as selected by user.

N. Current and Voltage Ratings:
   1. Designed for use with current inputs from standard instrument current transformers with 5-A secondary and shall have a metering range of 0-10 A.
   2. Withstand ratings shall not be less than 15 A, continuous; 50 A, lasting over 10 seconds, no more frequently than once per hour; 500 A, lasting 1 second, no more frequently than once per hour.
   3. Designed for use with voltage inputs from standard instrument potential transformers with a 120-V secondary.

O. Accuracy:
   1. Comply with ANSI C12.20, Class 0.5; and IEC 60687, Class 0.5 for revenue meters. Accuracy from Light to Full Rating shall meet the following criteria:
      a. Power: Accurate to 0.25 percent of reading, plus 0.025 percent of full scale.
      b. Voltage and Current: Accurate to 0.075 percent of reading, plus 0.025 percent of full scale.
      c. Power Factor: Plus or minus 0.002, from 0.5 leading to 0.5 lagging.
      d. Frequency: Plus or minus 0.01 Hz at 45 to 67 Hz.
   2. For meters that are circuit-breaker accessories, metering accuracy at full-scale shall not be less than the following:
      a. Current: Plus or minus 2.5 percent.
      b. Voltage: Plus or minus 1.5 percent.
      c. Energy, Demand, and Power: Plus or minus 4.0 percent.
      d. Frequency: Plus or minus 1 Hz.

P. Waveform Capture:

1. Capture and store steady-state waveforms of voltage and current channels; initiated manually. Each capture shall be for 3 cycles, 128 data points for each cycle, allowing resolution of harmonics to 31st harmonic of basic 60 Hz.
2. Store captured waveforms in internal nonvolatile memory; available for PC display, archiving, and analysis.

Q. Input: One digital input signal(s).
1. Normal mode for on/off signal.
2. Demand interval synchronization pulse, accepting a demand synchronization pulse from a utility demand meter.
3. Conditional energy signal to control conditional energy accumulation.

R. Outputs:
1. Operated either by user command sent via communication link or set to operate in response to user-defined alarm or event.
2. Closed in either a momentary or latched mode as defined by user.
3. Each output relay used in a momentary contact mode shall have an independent timer that can be set by user.
4. One digital KY pulse to a user-definable increment of energy measurement. Output ratings shall be up to 120-V ac, 300-V dc, 50 mA, and provide 3500-V rms isolation.
5. One relay output module(s), providing a load voltage range from 20- to 240-V ac or from 20- to 30-V dc, supporting a load current of 2 A.
6. Output Relay Control:
   a. Relay outputs shall operate either by user command sent via communication link or in response to user-defined alarm or event.
   b. Normally open and normally closed contacts, field configured to operate as follows:
      1) Normal contact closure where contacts change state for as long as signal exists.
      2) Latched mode when contacts change state on receipts of a pickup signal; changed state is held until a dropout signal is received.
      3) Timed mode when contacts change state on receipt of a pickup signal; changed state is held for a preprogrammed duration.
      4) End of power demand interval when relay operates as synchronization pulse for other devices.
      5) Energy Pulse Output: Relay pulses quantities used for absolute kWh, absolute kVARh, kVAh, kWh In, kVARh In, kWh Out, and kVARh Out.
      6) Output controlled by multiple alarms using Boolean-type logic.

S. Onboard Data Logging:
1. Store logged data, alarms, events, and waveforms in 800 KB of onboard nonvolatile memory.
2. Stored Data:
   a. Billing Log: User configurable; data shall be recorded every 15 minutes, identified by month, day, and 15-minute interval. Accumulate 24 months of monthly data, 32 days of daily data, and between 2 and 52 days of 15-minute interval data, depending on number of quantities selected.
   b. Custom Data Logs: One user-defined log(s) holding up to 96 parameters. Date and time stamp each entry to the second and include the following user definitions:
      1) Schedule interval.
      2) Event definition.
      3) Configured as "fill-and-hold" or "circular, first-in first-out."
   c. Alarm Log: Include time, date, event information, and coincident information for each defined alarm or event.
   d. Waveform Log: Store captured waveforms configured as "fill-and-hold" or "circular, first-in first-out."
3. Default values for all logs shall be initially set at factory, with logging to begin on device power up.

T. Alarms.
   1. User Options:
      a. Define pickup, dropout, and delay.
      b. Assign one of 4 severity levels to make it easier for user to respond to the most important events first.
      c. Allow for combining up to 4 alarms using Boolean-type logic statements for outputting a single alarm.
   2. Alarm Events:
      a. Over/undercurrent.
      b. Over/undervoltage.
      c. Current imbalance.
      d. Phase loss, current.
      e. Phase loss, voltage.
      f. Voltage imbalance.
      g. Over kW demand.
      h. Phase reversal.
      i. Digital input off/on.
      j. End of incremental energy interval.
      k. End of demand interval.

U. Control Power: 90- to 457-V ac or 100- to 300-V dc.

V. Communications:
   1. Power monitor shall be permanently connected to communicate via Modbus TCP via a 100 Base-T Ethernet.
   2. Local plug-in connections shall be for RS-232 and 100 Base-T Ethernet.

W. Display Monitor:
   1. Backlighted LCD to display metered data with touch-screen selecting device.
   2. Touch-screen display shall be a minimum 12-inch diagonal, resolution of 800 by 600 RGB pixels, 256 colors; NEMA 250, Type 1 display enclosure.
   3. Display 4 values on one screen at same time.
      a. Current, per phase rms, three-phase average and neutral.
      b. Voltage, phase to phase, phase to neutral, and three-phase averages of phase to phase and phase to neutral.
      c. Real power, per phase and three-phase total.
      d. Reactive power, per phase and three-phase total.
      e. Apparent power, per phase and three-phase total.
      f. Power factor, per phase and three-phase total.
      g. Frequency.
      h. Demand current, per phase and three-phase average.
      i. Demand real power, three-phase total.
      j. Demand apparent power, three-phase total.
      k. Accumulated energy (MWh and MVARh).
      l. THD, current and voltage, per phase.
   4. Reset: Allow reset of the following parameters at the display:
      a. Peak demand current.
      b. Peak demand power (kW) and peak demand apparent power (kVA).
      c. Energy (MWh) and reactive energy (MVARh).

2.08 STANDALONE, WEB-ENABLED MONITORING AND CONTROL INSTRUMENT

A. Separately mounted, permanently installed instrument for power monitoring and control.
   1. Enclosure: NEMA 250, Type 1.

B. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability.

1. Indoor installation in non-air-conditioned spaces that have environmental controls to maintain ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.

C. Power-Distribution Equipment Monitor: Web enabled, with integral network port and embedded Web server with factory-configured firmware and HTML-formatted Web pages for viewing of power monitoring and equipment status information from connected devices equipped with digital communication ports.

D. LAN Connectivity: Multipoint, RS-485 Modbus serial communication network, interconnecting all breaker trip units, protective relays, drives, and metering devices equipped with communications. Serial communication network connected to Ethernet server that functions as a gateway and server, providing data access via 100 Base-T LAN.

E. Communication Devices within the Equipment: Addressed at factory and tested to verify reliable communication with network server.

F. Server Configuration:
1. Initial network parameters set using a standard Web browser. Connect via a local operator interface, or an RJ-45 port accessible from front of equipment.
2. Network server shall be factory programmed with embedded HTML-formatted Web pages that are user configurable and that provide detailed communication diagnostic information for serial and Ethernet ports as status of RS-485 network; with internal memory management information pages for viewing using a standard Web browser.
3. Login: Password protected; password administration accessible from the LAN using a standard Web browser.
4. Operating Software: Suitable for local access; firewall protected.

G. Data Access:
1. Network server shall include embedded HTML pages providing real-time information from devices connected to RS-485 network ports via a standard Web browser.

H. Equipment Monitoring Options: Login shall be followed by a main menu for selecting summary Web pages that follow.

I. Summary Web pages shall be factory configured to display the following information for each communicating device within the power equipment lineup:
1. User-Configured Custom Home Page: Provide for the lineup, showing status-at-a-glance of key operating values.
2. Circuit Summary Page: Circuit name, three-phase average rms current, power (kW), power factor, and breaker status.
3. Load Current Summary Page: Circuit name, Phase A, B, and C rms current values.
4. Demand Current Summary Page: Circuit name, Phase A, B, and C average demand current values.
5. Power Summary Page: Circuit name, present demand power (kW), peak demand power (kW), and recorded time and date.
6. Energy Summary Page: Circuit name, energy (kWh), reactive energy (kVARh), and time/date of last reset.
7. Transformer Status Page: Transformer tag, coil temperatures, and cooling fan status.
8. Motor-Control Center Status Page: Circuit name, three-phase average rms current, thermal capacity (percentage), and drive output frequency (Hz) contactor status.
9. Specific Device Pages: Each individual communicating device shall display detailed, real-time information, as appropriate for device type.
   a. Display historical energy data that shall be logged automatically for each device, as appropriate for device type.
   b. Display historical data logged from each device in graphical time-trend plots. Value to be displayed on time-trend plot shall be user selectable. Time interval to be displayed on scale shall be for previous day or week.

10. Export historical energy data to a PC or workstation through network using FTP (File Transfer Protocol). Format exported data in a CSV (Comma Separated Variable) file format for importing into spreadsheet applications.

J. Communications:
   1. Power monitor: Permanently connected to communicate via Modbus TCP via a 100 Base-T Ethernet.
   2. Local Plug-in Connections: RS-232 and 100 Base-T Ethernet.
   3. Monitor Display: Backlighted LCD to display metered data with touch-screen selecting device.

2.09 RS-232 ASCII INTERFACE

A. ASCII interface shall allow RS-232 connections to be made between a meter or circuit monitor operating as the host PC and any equipment that will accept RS-232 ASCII command strings, such as local display panel.

B. Pager System Interface: Alarms shall be able to activate a pager system with customized message for each input alarm.
   1. RS-232 output shall be capable of connection to a pager interface that can be used to call a paging system or service and send a signal to a portable pager. System shall allow an individual alphanumeric message per alarm input to be sent to paging system. This interface shall support both numeric and alphanumeric pagers.

C. Alarm System Interface:
   1. RS-232 output shall be capable of transmitting alarms from other monitoring and alarm systems to workstation software.

D. Cables:
   1. PVC-Jacketed, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; PVC jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
      a. NFPA 70, Type CM.
      b. Flame Resistance: UL 1581, Vertical Tray.
   2. Plenum-Type, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; plastic jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
      a. NFPA 70, Type CMP.
      b. Flame Resistance: NFPA 262, Flame Test.

2.10 LAN CABLES

A. Comply with Section 27 15 13 "Copper Horizontal Cabling."

B. RS-485 Cable:
   1. PVC-Jacketed, RS-485 Cable: Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.
   2. Plenum-Type, RS-485 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket, and NFPA 70, Type CMP.

C. Unshielded Twisted Pair Cables: Category 6 as specified for horizontal cable for data service in Section 27 15 13 "Copper Horizontal Cabling."

2.11 LOW-VOLTAGE WIRING

A. Comply with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

B. Low-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.
   1. Sheath: PVC; except in plenum-type spaces, use sheath listed for plenums.

2. Ordinary Switching Circuits: Three conductors unless otherwise indicated.
3. Switching Circuits with Pilot Lights or Locator Feature: Five conductors unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CABLING

A. Comply with NECA 1.

B. Install cables and wiring according to requirements in Section 27 15 13 "Copper Horizontal Cabling."

C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

D. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

E. Install LAN cables using techniques, practices, and methods that are consistent with specified category rating of components and that ensure specified category performance of completed and linked signal paths, end to end.

F. Install cables without damaging conductors, shield, or jacket.

3.03 IDENTIFICATION

A. Identify components and power and control wiring according to Section 26 05 53 "Identification for Electrical Systems."

B. Label each power monitoring and control module with a unique designation.

3.04 GROUNDING

A. Comply with IEEE 1100, "Recommended Practice for Powering and Grounding Electronic Equipment."

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Contracting Agency will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:
   1. Electrical Tests: Use caution when testing devices containing solid-state components.
   2. Continuity tests of circuits.
   3. Operational Tests: Set and operate controls at workstation and at monitored and controlled devices to demonstrate their functions and capabilities. Use a methodical sequence that cues and reproduces actual operating functions as recommended by manufacturer. Submit sequences for approval. Note response to each test command and op-

eration. Note time intervals between initiation of alarm conditions and registration of alarms at central-processing workstation.

a. Coordinate testing required by this Section with that required by Sections specifying equipment being monitored and controlled.
b. Test LANs according to requirements in Section 27 15 13 "Copper Horizontal Cabling."
c. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of calculated battery operating time.
d. Verify accuracy of graphic screens and icons.
e. Metering Test: Load feeders, measure loads on feeder conductor with a rms reading clamp-on ammeter, and simultaneously read indicated current on the same phase at central-processing workstation. Record and compare values measured at the two locations. Resolve discrepancies greater than 5 percent and record resolution method and results.
f. Record metered values, control settings, operations, cues, time intervals, and functional observations and submit test reports printed by workstation printer.

E. Power monitoring and control equipment will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Correct deficiencies make necessary adjustments, and retest. Verify that specified requirements are met.

H. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

I. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

J. Remove and replace malfunctioning devices and circuits and retest as specified above.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Contracting Agency's maintenance personnel to adjust, operate, and maintain systems. See Section 1-05.11 "Facility Startup, Testing and Training."

1. Train Contracting Agency's management and maintenance personnel in interpreting and using monitoring displays and in configuring and using software and reports. Include troubleshooting, servicing, adjusting, and maintaining equipment. Provide a minimum of 12 hours' training.
2. Training Aid: Use approved final versions of software and maintenance manuals as training aids.

3.07 ON-SITE ASSISTANCE

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to 3 visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 26 09 13

This page intentionally left blank

SECTION 26 09 43

NETWORK LIGHTING CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes a networked lighting control system comprised of the following components
   1. System Software Interfaces
      a. Management Interface
      b. Historical Database and Analytics Interface
      c. Visualization Interface
      d. Personal Control Applications
      e. Smartphone Programming Interface for wired devices
   2. System Backbone and Integration Equipment
      a. System Controller
      b. OpenADR Interface
   3. Wired Networked Devices
      a. Wall Switches, Dimmers and Scene Controllers
      b. Graphic Wallstations
      c. Auxiliary Input/Output Devices
      d. Occupancy and Photocell Sensors
      e. Wall Switch Sensors
      f. Embedded Sensors
      g. Power Packs and Secondary Packs
      h. Networked Luminaires
      i. Relay and Dimming Panel
      j. Bluetooth® Low Energy Programming Device
      k. Communication Bridge
   4. The networked lighting control system shall meet all of the characteristics and performance requirements specified herein.
   5. The contractor shall provide, install and verify proper operation of all equipment necessary for proper operation of the system as specified herein and as shown on applicable drawings.

1.02 RELATED DOCUMENTS

A. Section 26 27 26 Wiring Devices

B. Section 26 51 13 Interior Lighting Fixtures

1.03 SUBMITTALS

A. Submittal shall be provided including the following items.
   1. Bill of Materials necessary to install the networked lighting control system.
   2. Product Specification Sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.
   3. Riser Diagrams showing device wiring connections of system backbone and floor plans pertinent to the specific project. Engineers design drawings returned back to the Engineer for review are not acceptable.
      a. Information Technology (IT) connection information pertaining to interconnection with facility IT networking equipment and third-party systems. The list shall include a checklist with all required information needed from the IT and required dates.
      b. Diagrams and Operational Descriptions to indicate system operation or interaction with other system(s).
      c. Contractor Startup/Commissioning Worksheet (must be completed prior to factory startup).
      d. Service Specification Sheets indicating general service descriptions, including startup, training, post-startup support, and service contract terms.
      e. Hardware and Software Operation Manuals.

1.04 APPROVALS

A. Prior approval from owner's representative is required for products or systems manufactured by companies not specified in the Network Lighting Controls section of this specification.

B. Any alternate product or system that has not received prior approval from the owner's representative at least 10 days prior to submission of a proposal package shall be rejected.

C. Alternate products or systems require submission of catalog datasheets, system overview documents and installation manuals to owner's representative. The submittal shall include significant differences between the specified product and the alternate.

1.05 QUALITY ASSURANCE

A. Product Qualifications
   1. System electrical components shall be listed or recognized by a nationally recognized testing laboratory (e.g., UL, ETL, or CSA) and shall be labeled with required markings as applicable.
   2. System luminaires and controls shall be designed and manufactured for interoperability.
   3. All components shall be subjected to 100% end of line testing prior to shipment to the project site to ensure proper device operation.
   4. All components and the manufacturing facility where product was manufactured must be RoHS compliant.

B. Installation and Startup Qualifications
   1. System start-up shall be performed by qualified personnel approved or certified by the manufacturer.

C. Service and Support Requirements
   1. Phone Support: Toll free technical support shall be available.
   2. Remote Support: The bidder shall offer a remote support capability.
   3. Onsite Support: The bidder shall offer onsite support that is billable at whole day rates.
   4. Service Contract: The bidder shall offer a Service Contract that packages phone, remote, and onsite support calls for the project. Response times for each type of support call shall be indicated in the terms of the service contract included in the bid package.

1.06 PROJECT CONDITIONS

A. Only install equipment after the following site conditions are maintained:
   1. USC Ambient Temperature: 14 to 105˚F.{USC}
   2. Relative Humidity: less than 90% non-condensing

B. Equipment shall not be subjected to dust, debris, moisture, or temperature and humidity conditions exceeding the requirements indicated above, at any point prior to installation.

C. Only properly rated equipment and enclosures, installed per the manufacturer's instructions, may be subjected to dust and moisture following installation.

1.07 WARRANTY

A. The manufacturer shall provide a minimum five-year warranty on all hardware devices supplied and installed. Warranty coverage shall begin on the date of shipment.

B. The hardware warranty shall cover repair or replacement, including programming, any defective products within the warranty period.

1.08 MAINTENANCE & SUSTAINABILITY

A. The manufacturer shall make available to the owner new parts, upgrades, and/or replacements available for a minimum of 5 years following installation.

PART 2 EQUIPMENT

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   1. nLight, Acuity Brands Lighting, Inc.

2. Encellium
3. WattStopper
4. nLight, Acuity Brands Lighting, Inc.
5. Enlighted
6. Lutron Vive

B. Basis of Design System: Acuity Controls nLight

C. Basis of BAS Control Integration: Distech Controls ECLYPSE

2.02 SYSTEM COMPLIANCE

A. System components shall comply with UL 916 and UL 924 standards where applicable.

B. System components shall comply with CFR Title 47, Part 15 standards where applicable.

C. All equipment shall be installed and connected in compliance with NFPA 70.

2.03 SYSTEM PERFORMANCE REQUIREMENTS

A. System Architecture

1. System shall have an architecture that is based upon three main concepts: (1) networkable intelligent lighting control devices, (2) standalone lighting control zones using distributed intelligence, (3) optional system backbone for remote, time based and global operation between control zones.
2. Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 10V input, and manual wallstation capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible so as to minimize overall device count of system.
3. System must be capable of interfacing directly with networked luminaires such that low voltage network cabling is used to interconnect networked luminaires with control components such as sensors, switches and system backbone (see Control Zone Characteristics sections for wired network connection).
4. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wallstations without requiring connection to a higher level system backbone; this capability is referred to as “distributed intelligence.”
   a. Lighting control zones (wired) of at least 128 devices per zone shall be supported.
5. The system shall be capable of providing individually addressable switching and dimming control of the following: networked luminaires, control zones, and relay and dimming outputs from centralized panels to provide design flexibility appropriate with sequence of operations required in each project area or typical space type.
6. Networked luminaires and intelligent lighting control devices shall support individual (unique) configuration of device settings and properties.
7. Networked luminaires and intelligent lighting control devices shall have distributed intelligence programming stored in non-volatile memory such that following any loss of power the lighting control zones shall operate according to their defined default settings and sequence of operations.
8. Lighting control zones shall be capable of being networked with a higher level system backbone to provide time based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software interface.
9. The system may include one or more system controllers that provide time-based control and global system control across multiple control zones and backbone network segments. The system controller also provides a means of connecting the lighting control system to a system software interface and building management systems via BACnet/IP protocol.

10. The system may include “communication bridge” devices that route communication from lighting control zones (wired or wireless) to and from the system controller, for purposes of decreasing system wiring requirements.
11. All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality at a later date.

B. Wired Networked Control Zone Characteristics
1. Connections to devices within a wired networked lighting control zone and to backbone components shall be with a single type of low voltage network cable, which shall be compliant with CAT5e specifications or higher. To prevent wiring errors and provide cost savings, the use of mixed types of low voltage network cables shall not be permitted.
2. Devices in an area shall be connected via a “daisy-chain” topology; requiring all individual networked devices to be connected back to a central component in a “hub-and-spoke” topology shall not be permitted, so as to reduce the total amount of network cable required for each control zone.
3. System shall provide the option of having pre-terminated plenum rated low voltage network cabling supplied with hardware so as to reduce the opportunity for improper wiring and communication errors during system installation.
4. Following proper installation and provision of power, all networked devices connected together with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The “out of box” default sequence of operation is intended to provide typical sequence of operation so as to minimize the system start-up and programming requirements and to also have functional lighting control operation prior to system start-up and programming.
5. Once software is installed, system shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.
6. All networked devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/start-up personnel.
7. Networked control devices intended for control of egress and/or emergency light sources shall not require the use of additional, externally mounted UL924 shunting and/or 0-10V disconnect devices, so as to provide a compliant sequence of operation while reducing the overall installation and wiring costs of the system. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
    a. Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.
    b. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss of power sensed via line voltage connections.

C. System Integration Capabilities
1. The system shall interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet/MSTP protocols. The following system integration capabilities shall be available via BACnet/IP and BACnet/MSTP protocols:
    a. The system shall support control of individual devices, including, but not limited to, control of relay and dimming output. All system devices shall be available for control.
    b. The system shall support reading of individual device status information, including but not limited to, relay state, dimming output, power measurement, occupancy sensor status, and photocell sensor states or readings. All system devices shall be available for polling for devices status.
    c. The system shall support activation of pre-defined system Global Profiles (see Supported Sequence of Operations for further definition of Global Profile capabilities).

d. The system shall support activation of Profiles (local or global) and Preset Scenes from third party systems by receiving dry contact closure output signals or digital commands via RS-232/RS-485.
e. The system shall support activation of system profiles from Demand Response Automation Servers via the OpenADR 2.0a protocol.

D. Supported Sequence of Operations
1. The following characteristics and performance requirements shall apply to wired and wireless control zones provided by the system.
2. Control Zones
a. Networked luminaires and intelligent lighting control devices installed in an area (also referred to as a group of devices) shall be capable of transmitting and tracking occupancy sensor, photocell sensor, and manual switch information within at least 48 unique control zones to support different and reconfigurable sequences of operation within the area. These shall also be referred to as local control zones.
b. Networked luminaires and intelligent lighting control devices located in different areas shall be able to transmit and track occupancy, photocell, and switch information within at least 128 system-wide control zones to support required sequences of operation that may span across multiple areas. These shall also be referred to as global control zones.
3. Wallstation Capabilities
a. Wallstations shall be provided to support the following capabilities:
1) On/Off of a local control zone and global control zone simultaneously, as required.
2) Continuous dimming control of light level of a local control zone and global control zone simultaneously, as required.
3) Preset Scenes that can activate a specific combination of light levels across multiple local and global channels, as required.
4) Profile Scenes that can modify the sequence of operation for the devices in the area (group) in response to a button press. This capability is defined as supporting “Local Profiles” and is used to dynamically optimize the occupant experience and lighting energy usage. Parameters that shall be configurable and assigned to a Local Profile include light level, response to occupancy sensors (including enabling/disabling response), response to daylight sensors (including enabling/disabling response) and enabling/disabling of wallstations.
b. Dimming control to allow color tuning between 3000 and 5000K (Kelvin)
1) 3-way / multi-way control: multiple wallstations shall be capable of controlling the same local and global control zones, so as to support “multi-way” switching, dimming, preset scene, and profile scene control.
4. Occupancy Sensing Capabilities
a. Local and global control: Occupancy sensors shall be configurable to control a local and global zone simultaneously, as required.
b. Multi-sensor control: multiple occupancy sensors shall be capable of controlling the same local and global control zones. This capability combines occupancy sensing coverage from multiple sensors without consuming multiple control zone addresses.
c. System shall support the following types of occupancy sensing sequence of operations:
1) On/Off Occupancy Sensing
2) Partial-On Occupancy Sensing
3) Partial-Off Occupancy Sensing
4) Vacancy Sensing (Manual-On / Automatic-Off)

d. On/Off, Partial-On, and Partial-Off Occupancy Sensing modes shall function according to the following sequence of operation:
    1) Occupancy sensors automatically turn lights on to a designated level when occupancy is detected. To support fine tuning of Partial-On sequences the designated occupied light level shall support at least 100 dimming levels.
    2) Occupancy sensors automatically turn lights off or to a dimmed state(Partial-Off) when vacancy occurs or if sufficient daylight is detected. To support fine tuning of Partial-Off sequences the designated unoccupied dim level shall support at least 100 dimming levels.
    3) To provide additional energy savings the system shall also be capable of combining Partial-Off and Full-Off operation by dimming the lights to a designated level when vacant and then turning the lights off completely after an additional amount of time.
    4) Photocell readings, if enabled in the Occupancy Sensing control zone, shall be capable of automatically adjusting the light level during occupied or unoccupied conditions as necessary to further reduce energy usage. Additional requirements and details for photocell sensing capabilities are indicated under Photocell Sensing Capabilities.
    5) The use of a wallstation shall change the dimming level or turn lights off as selected by the occupant. The lights shall remain in this manually-specified light level until the zone becomes vacant; upon vacancy the normal sequence of operation, as defined above, shall proceed.

e. Vacancy Sensing mode (also referred to as Manual-On / Automatic-Off) shall function according to the following sequence of operation:
    1) The use of a wallstation is required turn lights on. The system shall be capable of programming the zone to turn on to either to a designated light level or the previous light level. Initially occupying the space without using a wallstation shall not result in any change in light level.
    2) Occupancy sensors shall automatically turn lights off when vacancy occurs is detected. To provide an enhanced occupant experience the system shall also be capable of dimming the lights when vacant and then turning the lights off completely after an additional amount of time.
    3) To minimize occupant impact in case the area or zone is still physically occupied following dimming or shutoff of the lights due to detection of vacancy, the system shall support an “automatic grace period” immediately following detection of vacancy, during which time any detected occupancy shall result in the lights reverting to the previous level. After the grace period has expired, the use of a wallstation is required to turn lights on.
    4) Photocell readings, if enabled in the Occupancy Sensing control zone, shall be capable of automatically adjusting the light level as necessary to further reduce energy usage. Additional requirements and details for photocell sensing capabilities are indicated under Photocell Sensing Capabilities.
    5) At any time, the use of a wallstation shall change the dimming level or turn lights off as selected by the occupant. The lights shall remain in this manually-specified light level until the zone becomes vacant; upon vacancy the normal sequence of operation, as defined above, shall proceed.

f. To accommodate different types of environments, vacancy time delays before dimming or shutting off lights shall be specifiable for control zones between 15 seconds to 2 hours.

5. Photocell Sensing Capabilities (Automatic Daylight Sensing)
    a. Photocell sensing devices shall be configurable to control a local and global zone simultaneously, as required.
    b. The system shall support the following types of photocell-based control:
        1) On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading

is below the defined setpoint. A time delay or adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching.

2) Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.

6. Schedule and Global Profile Capabilities
   a. The system shall be capable of automatically modifying the sequence of operation for selected devices in response to any of the following: a time-of-day schedule, contact closure input state, RS-232/RS-485 command, BACnet input command, and demand response signal. This capability is defined as supporting “Global Profiles” and is used to dynamically optimize the occupant experience and lighting energy usage.
   b. Scheduling. Global profiles may be scheduled with the following capabilities:
      1) Global Profiles shall be stored within and executed from the system controller (via internal timeclock) such that a dedicated software host or server is not required to be online to support automatic scheduling and/or operation of Global Profiles.
      2) Global Profile time of day schedules shall be capable of being given the following recurrence settings: daily, specific days of week, every “n” number of days, weekly, monthly, and yearly. Lighting control profile schedules shall support definition of start date, end date, end after “n” recurrences, or never ending. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
      3) Global Profiles shall be capable of being scheduled to run according to timed offsets relative to sunrise or sunset. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
      4) Blink warning and timed extension capabilities. At the end of a scheduled period, the system shall be capable of providing a visible “blink warning” 5 minutes prior to the end of the schedule. Wallstations may be programmed to provide timed overrides that turn the lights on for an additional period of time. Timed override duration shall be programmable for each individual device, zone of devices, or customized group of devices, ranging from 5 minutes to 12 hours.
      5) Software management interface shall be capable of displaying a graphic calendar view of profile schedules for each control zone.
   c. System Global Profiles shall have the following additional capabilities:
      1) Global Profiles shall be capable of being manually activated directly from the system controller, specially programmed input devices, and software management interface.
      2) Global Profiles shall be selectable to apply to a single device, zone of devices, or customized group of devices.
      3) Parameters that shall be configurable and assigned to a Global Profile include light level, response to occupancy sensors (including enabling/disabling response), response to daylight sensors (including enabling/disabling response) and enabling/disabling of wallstations.
   d. A backup of Local and Global Profiles shall be stored on the software’s host server such that the Profile backup can be applied to a replacement system controller or wallstation.
7. Automated demand response capabilities. Profiles created for automated demand response events shall support automatic reduction of light level to programmable values. At least four levels of demand response profiles shall be supported by the system.

2.04 SYSTEM SOFTWARE INTERFACES

A. Management Interface
   1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.
   2. Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer®, Apple Safari®, Google Chrome®, Mozilla Firefox®.
   3. Management interface shall require all users to login with a User Name and Password and shall support creation of at least 100 unique user accounts.
   4. Management interface shall support at least three permission levels for users: read-only, read & change settings, and full administrative system access.
   5. Management interface shall be capable of restricting read-only and read & change access for user accounts to specific devices within the system.
   6. All system devices shall be capable of being given user-defined names.
   7. The following device identification information shall be displayed in the Management interface: model number, model description, serial number, manufacturing date code custom label(s), and parent network device.
   8. Management interface shall be able to read the live status of a networked luminaire or intelligent control device and shall be capable of displaying luminaire on/off status, dim level, power measurement, device temperature, PIR occupancy sensor status, microphonic occupancy sensor status, remaining occupancy time delay, photocell reading, and active Scenes or Profiles.
   9. Management interface shall be able to read the current active settings of a networked luminaire or intelligent control device and shall be capable of displaying dimming trim levels, occupancy sensor and photocell enable/disable, occupancy sensor time delay and light level settings, occupancy sensor response (normal or vacancy), and photocell setpoints and transition time delays.
   10. Management interface shall be able to change the current active settings and also default settings for an individual networked luminaire or intelligent control device.
   11. Management interface shall be capable of applying settings changes for a zone of devices or a group of selected devices using a single “save” action that does not require the user to save settings changes for each individual device.
   12. A printable network inventory report shall be available via the management interface.
   13. A printable report detailing all system profiles shall be available via the management interface.
   14. All sensitive information stored by the software shall be encrypted.
   15. All system software updates must be available for automatic download and installation via the Internet.

B. Historical Database and Analytics Interface
   1. System shall provide a historical database that stores device operational history and calculates energy usage for all networked luminaires and intelligent control devices.
   2. System shall be capable of reporting lighting system events and performance data back to the historical database for display and analysis.
   3. Historical database shall be capable of recording historical data for up to 20,000 networked devices for a period of at least 1 calendar year.
   4. An “Energy Scorecard” shall be displayed that shows calculated energy savings in dollars, kWh, or CO2.
   5. Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching, etc.).
   6. Energy savings data shall be calculated for the system as a whole or for individual zones.
   7. A time scaled graph showing all relay transitions shall be presented.
   8. A time scaled graph showing a zones occupancy time delay shall be presented

9. A time scaled graph showing the total light level shall be presented.
10. User shall be able to customize the baseline run-time hours for a space.
11. User shall be able to customize up to four time-of-day billing rates and schedules.
12. Historical data shall be exportable from the Historical Database via a “CSV” type of file format.

C. Visualization Interfaces
1. System shall provide a web-based visualization interface that displays graphical floorplan.
2. Graphical floorplan shall offer the following types of system visualization:
   a. Full Device Option - A master graphic of the entire building, by floor, showing each control device installed in the project with zones outlined to include but not be limited to the following:
      1) Controls embedded light fixtures
      2) Controls devices not embedded in light fixtures
      3) Daylight Sensors
      4) Occupancy Sensors
      5) Wall Switches and Dimmers
      6) Scene Controllers
      7) Networked Relays
      8) Bridges
      9) System Controllers
      10) Panels
      11) Zone outlines
   b. Zone Only Option - A master graphic of the entire building, by floor, showing control zones:
      1) Zones outlined
   c. Allow for pan and zoom commands so smaller areas can be displayed on a larger scale simply by panning and zooming each floor’s master graphic.
   d. A mouse click on any control device shall display the following information (as applicable):
      1) The device catalog number.
      2) The device name and custom label.
      3) Device diagnostic information.
      4) Information about the device status or current configuration is available with an additional mouse click.

D. Personal Control Applications
1. Software interface shall support personal control software applications that provide user-specific control of individual luminaires, control zones, and scene presets.
2. Personal control applications shall support control of dimming output or definition of dimming presets for luminaires and devices that are dimmable.
3. The system administrator shall be capable of defining personal control permissions for each user account.
4. Software interface shall provide a Microsoft Windows® operating system taskbar application for personal lighting control.
5. Software interface shall provide an Apple iOS® operating system application (supported by mobile phones and mobile tablet devices) for personal lighting control.

E. Smartphone Programming Interface for Wired Devices
1. Application interface shall be provided for both Apple iOS® and Android operating systems that allows configuration of lighting control settings.
2. The application shall support the configuration of wired networked control devices via a Bluetooth® Low Energy (BLE) Programming Device.
   a. Application shall support a security pin-code to access the zone of lighting control devices.

b. The application shall provide indication of signal strength where multiple Bluetooth Low Energy Programming Devices are available for configuration.
c. The application shall indicate the number of wired networked control devices.

3. Programming capabilities through the application shall include, but not be limited to, the following:
   a. Switch/occupancy/photosensor group configuration
   b. Manual/automatic on modes
   c. Turn-on dim level
   d. Occupancy sensor time delays
   e. Dual technology occupancy sensors sensitivity
   f. Trim level settings

2.05 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

A. IP nLight ECLYPSE™ System Controller (IP-NE-CTRL)
   1. System Controller shall be multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
   2. System Controller shall have 32-bit microprocessor operating at a minimum of 1 GHz.
   3. System Controller shall have minimum of 512MB memory, with a minimum of 4GB non-volatile flash, to support its own operating system and databases.
   4. System Controller shall perform the following functions:
      a. Facilitation of global network communication between different areas and control zones.
      b. Time-based control of downstream wired and wireless network devices.
      c. Linking into an Ethernet network.
      d. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
      e. Connection to various software interfaces, including management interface, historical database and analytics interface, visualization interface, and personal control applications.
   5. System Controller shall have an integral web server to support configuration, diagnostics and hosting of software interfaces.
   6. Device shall have option for a graphical touch screen to support configuration and diagnostics.
   7. Device shall have three RJ-45 networked lighting control ports for connection to any of the following:
      a. The graphical touch screen
      b. Wired communication bridges
      c. Direct connection to networked wired luminaires and intelligent lighting control devices (up to 128 total devices per port)
   8. Device shall be capable of communicating with wireless mesh network bridges and software interfaces via LAN connection.
   9. Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.
   10. Device shall have a standard internal time clock.
   11. Device shall have 2 switched RJ-45 10/100 BaseT Ethernet ports for local area network (LAN) connection
      a. Ethernet connection shall support daisy chain wiring to other lighting control system LAN devices, such as other system controllers and wireless mesh networked communication bridges.
      b. Ethernet connection shall support IPv4 and shall be capable of using a dedicated static or DHCP assigned IP address.

12. Device shall have 2 x USB 2.0 Expansion ports for
    a. 802.11 Wi-Fi Adapter enabling wireless connectivity including:
        1) Hot Spot
        2) Access Point
        3) Client
        4) Spanning Tree Protocol
13. Each System Controller shall be capable of managing and operating at least 1500 networked devices (wired or wireless).
    a. Multiple System Controllers may be networked together via LAN connection to scale the system up to 20,000 networked devices.
14. System Controller shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.
    a. BACnet/MSTP shall support up to minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.
    b. BACnet/MSTP shall support 9600 to 115200 baud.
    c. System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
    d. Shall contain a “FIPS 140-2 Level 1 Compliant” cryptographic module.

B. OpenADR Interface
1. System shall provide an interface to OpenADR protocol Demand Response Automation Servers (DRAS) typically provided by local electrical utility.
2. OpenADR interface shall meet all of the requirements of Open ADR 2.0a Virtual End Nodes(VEN), including:
    a. Programmable with the account information of the end-user’s electrical utility DRAS account credentials.
3. OpenADR interface shall support the activation of system profiles configured for each of the automated demand response levels defined in the utility demand response program.

2.06 WIRED NETWORKED DEVICES

A. Wired Networked Wall Switches, Dimmers, Scene Controllers
1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
2. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
3. All switches shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
4. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
5. Devices with mechanical push-buttons shall be made available with custom button labeling.
6. Wall switches & dimmers shall support the following device options:
    a. Number of control zones: 1, 2 or 4
    b. Control Types Supported: On/Off or On/Off/Dimming
    c. Colors: Ivory, White, Light Almond, Gray, Black, Red
7. Scene controllers shall support the following device options:
    a. Number of scenes: 1, 2 or 4
    b. Control Types Supported:
        1) On/Off
        2) On/Off/Dimming
        3) Preset Level Scene Type
        4) Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene
        5) Selecting a lighting profile to be run by the system’s upstream controller so as to implement a selected lighting profile across multiple zones
        6) Colors: Ivory, White, Light Almond, Gray, Black, Red

7) Color tuning dimming to allow between 3000 and 5000K (Kelvin)

B. Wired Networked Graphic Wallstations
1. Device shall surface mount to single-gang switch box.
2. Device shall have a 3.5” full color touch screen.
3. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply.
4. Device shall have a micro-USB style connector for local computer connectivity.
5. Communication shall be over standard low voltage network cabling with RJ-45 connectors.
6. Device shall enable user supplied screen saver image to be uploaded within one of the following formats: jpg, png, gif, bmp, tif.
7. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
8. Graphic wallstations shall support the following device options:
   a. Number of control zones: Up to 16
   b. Number of scenes: Up to 16
   c. Colors: Ivory, White, Light Almond, Gray, Black

C. Wired Networked Auxiliary Input / Output (I/O) Devices
1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a □ in knockout.
2. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
3. Auxiliary Input/Output Devices shall be specified as an input or output device with the following options:
   a. Contact closure input
      1) Input shall be programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.
   b. 0-10V analog input
      1) Input shall be programmable to function as a daylight sensor.
   c. RS-232/RS-485 digital input
      1) Input supports activation of local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
   d. 0-10V dimming control output, capable of sinking up to 20mA of current
      1) Output shall be programmable to support all standard sequence of operations supported by system.

D. Wired Networked Occupancy and Photosensors
1. Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional “dual” technology shall be used.
4. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR / Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR / Ultrasonic) shall not be acceptable.
5. All sensing technologies shall be acoustically passive, meaning they do not transmit sound waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive

Infrared(PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.

6. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
7. All sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
8. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device push-button.
9. Network system shall have ceiling, fixture, recessed & corner mounted sensors available, with multiple lens options available customized for specific applications.
10. Sensors shall be available with zero or one integrated dry contact switching relays, capable of switching 1 amp at 24 VAC/VDC (resistive only).
11. Sensors shall be available with one or two occupancy “poles”, each of which provides a programmable time delay.
12. Sensors shall have optional features for photosensor/daylight override, dimming control, and low temperature/high humidity operation.
13. Photosensor shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
14. Photosensor and dimming sensor’s set-point and deadband shall be automatically calibrated through the sensor’s microprocessor by initiating an “Automatic Set-point Programming” procedure. Min and max dim settings as well as set-point may be manually entered.
15. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
16. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The secondary daylight zone shall be capable of being controlled as an “offset” from the primary zone.

E. Wired Networked Wall Switch Sensors
   1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
   2. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
   3. All wall switch sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
   4. Devices with mechanical push-buttons shall provide tactile user feedback.
   5. Wall switches sensors shall support the following device options:
      a. User Input Control Types Supported: On/Off or On/Off/Dimming
      b. Occupancy Sensing Technology: PIR only or Dual Tech acoustic
      c. Daylight Sensing Option: Inhibit Photosensor
      d. Colors: Ivory, White, Light Almond, Gray

F. Wired Networked Embedded Sensors
   1. Network system shall have embedded sensors consisting of occupancy sensors and/or dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.
   2. USC Occupancy sensor detection pattern shall be suitable for 7.5 ft. to 20 ft. mounting heights. USC
   3. Embedded sensors shall support the following device options:
      a. Occupancy Sensing technology: PIR only or Dual Tech acoustic
      b. Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor

G. Wired Networked Power Packs and Secondary Packs
   1. Power Packs shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
   2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC) and carry a plenum rating.
   3. Secondary Packs shall incorporate the relay and 0-10 VDC or line voltage dimming output but shall not be required to contribute system power.
   4. Power Supplies shall provide system power only but are not required to switch line voltage circuit.
   5. Auxiliary Relay Packs shall switch low voltage circuits only, capable of switching 1 amp at 40 VAC/VDC (resistive only).
   6. Communication shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors. Secondary packs shall receive low voltage power via standard low voltage network cable.
   7. Power Pack programming parameter shall be available and configurable remotely from the software and locally via the device push-button.
   8. Power Pack shall securely mount to junction location through a threaded □ in chase nipple or be capable of being secured within a luminaire ballast/driver channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
   9. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
   10. Power/Secondary Packs shall be available with the following options:
   11. Power Pack capable of full 16-Amp switching of all normal power lighting load types, with optional 0-10V dimming output capable of up to 100mA of sink current.
   12. Secondary Pack with UL924 listing for switching of full 16-Amp Emergency Power circuits, with optional 0-10V dimming output capable of up to 100mA of sink current.
   13. Power and Secondary Packs capable of full 20-Amp switching of general purpose receptacle (plug-load) control.
   14. Secondary Pack capable of full 16-Amp switching of all normal power lighting load types.
   15. Secondary Pack capable of 5-Amps switching and dimming 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and3-wire versions).
   16. Secondary Pack capable of 5-Amps switching and dimming of 120/277 VAC magnetic low voltage transformers.
   17. Secondary Pack capable of 4-Amps switching and dimming of 120 VAC electronic low voltage transformers.
   18. Secondary Pack capable of louver/damper motor control for skylights.
   19. Secondary Pack capable of providing a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
   20. Secondary Pack capable of switching 1 amp at 40 VAC/VDC (resistive only) with the intent to provide relay signal to auxiliary system (e.g. BMS).
   21. Power Supply capable of providing auxiliary bus power (no switched or dimmed load).

H. Wired Networked Relay and Dimming Panel
   1. Relay and dimming panel shall be available with 4, 8, 12 or 16 individual Field Configurable Relays (FCR) per panel, with an equal number of individual 0-10V dimming outputs.
   2. Standard relays used shall have the following required properties:
      a. Configurable in the field to operate with single-, double-, or triple-pole relay groupings.
      b. Configurable in the field to operate with normally closed or normally open behavior.

c. Provides visual status of current state and manual override control of each relay.
d. Listed for the following minimum ratings:
1) 40A@120-480VAC Ballast
2) 16A@120-277VAC Electronic
3) 20A@120-277VAC Tungsten
4) 20A@48VDC Resistive
5) 2HP @ 120VAC,
6) 3HP @ 240-277VAC
7) 65kA SCCR @ 480VAC

3. 0-10 dimming outputs shall support a minimum of 100mA sink current per output.
4. Relay and dimming outputs shall be individually programmable to support all standard sequence of operations as defined in this specification.
5. Panel shall be UL924 listed for control of emergency lighting circuits.
6. Panel shall power itself from an integrated 120-277VAC or 347VAC supply.
7. Panel shall provide a configurable low-voltage sensor input with the following properties:
8. Configurable to support any of the following input types:
a. Indoor Photocell
b. Outdoor Photocell
c. Occupancy Sensor
d. Contact Closure
1) Low voltage sensor input shall provide +24VDC power for the sensor so that additional auxiliary power supplies are not required.
2) Sensor input supports all standard sequence of operations as defined in this specification.
9. Panel shall provide a contact closure input that acts as a panel override to activate the normally configured state of all relays (i.e., normally open or normally closed) in the panel. This input is intended to provide an interface to alarm systems, fire panels, or BMS system to override the panel.
10. Panel shall supply current limited low voltage power to other networked devices connected via low voltage network cable.
11. Panel shall be available with NEMA 1 rated enclosure with the following properties:
a. Surface-mounted or flush-mounted enclosure back box
b. Screw-fastened cover or hinged cover with keyed lock
12. USC Panel shall be rated from 32-122 °F. USC

I. Wired Networked Bluetooth® Low Energy Programming Device
1. Device shall be plenum rated and be inline wired, screw mountable.
2. Communication and low voltage power shall be delivered to device via standard low voltage network cabling with RJ-45 connectors.
3. Bluetooth Low Energy connection shall allow connection from smartphone application for programming device settings within the local daisy-chain zone (see list of available settings in section, 2.4-System Software Interfaces, Sub-section .5).
a. Device shall provide visual indication of remote Bluetooth connection via LED integrated into device enclosure such that it is visible from all angles while the zone is being programmed.

J. Wired Networked Communication Bridge
1. Device shall surface mount to a standard 4” x 4” square junction box.
2. Device shall have 8 RJ-45 ports for connection to lighting control zones (up to 128 devices per port), additional network bridges, and System Controller.
3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to System Controller.
4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or powered via low voltage network connections from powered lighting control devices (e.g. power packs).

5. Wired Bridge shall be capable of redistributing power from its local supply and connected lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

PART 3 EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. Installation Procedures and Verification
   1. The successful bidder shall review all required installation and pre-startup procedures with the manufacturer's representative through pre-construction meetings.
   2. The successful bidder shall install and connect the networked lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals and plans specifications.
   3. The successful bidder shall be responsible for testing of all lighting control low voltage network cable included in the bid. Bidder is responsible for verification of the following minimum parameters:
      a. Wire Map (continuity, pin termination, shorts and open connections, etc.)
      b. Length
      c. Insertion Loss

B. Coordination with Owner's IT Network Infrastructure
   1. The successful bidder is required to coordinate with the owner's representative to secure all required network connections to the owner's IT network infrastructure.
      a. The bidder shall provide to the owner's representative all network infrastructure requirements of the networked lighting control system.
      b. The bidder shall provide to the manufacturer's representative all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.

C. Documentation and Deliverables
   1. The installing contractor shall be responsible for documenting installed location of all networked devices, including networked luminaires. This includes responsibility to provide as-built plan drawing showing device address barcodes corresponding to locations of installed equipment.
   2. The installing contractor is also responsible for the following additional documentation to the manufacturer's representative if visualization / graphical floorplan software is provided as part of bid package:
      a. As-Built floor plan drawings showing daisy-chain wired network control zones outlined, in addition to device address locations required above. All documentation shall remain legible when reproducing scanning drawing files for electronic submission.
      b. As-Built electrical lighting drawings (reflected ceiling plan) in PDF and CAD format. Architectural floor plans shall be based on as-built conditions.
         1) CAD files shall have layers already turned on/off as desired to be shown in the graphical floorplan background images. The following CAD elements are recommended to be hidden to produce an ideal background graphical image:
            a) Titleblock
            b) Text- Inclusive of room names and numbers, fixture tags and drawings notes
            c) Fixture wiring and homeruns
            d) Control devices
            e) Hatching or poch of light fixtures or architectural elements
         2) CAD files shall be of AutoCAD 2013 or earlier. Autodesk Revit files overall floor plan views shall be exported to AutoCAD 2013.

3.02 SYSTEM STARTUP

A. Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed by an authorized representative of the manufacturer.
   1. Low voltage network cable testing shall be performed prior to system startup.

B. System start-up and programming shall include:
   1. Verifying operational communication to all system devices.
   2. Programming the network devices into functional control zones to meet the required sequence of operation.
   3. Programming and verifying all sequence of operations.
   4. Customization of owner's software interfaces and applications.

C. Initial start-up and programming is to occur on-site. Additional programming may occur on-site or remotely over the Internet as necessary.

3.03 PROJECT TURNOVER

A. System Documentation and as-builts.
   1. Submit software database file with desired device labels and notes completed.

B. Owner Training
   1. Provisions for onsite training for owner and designated attendees to be included in submittal package. Training shall be a minimum of (1) day and shall be videotaped by the Contractor, and video provided to the Owner.
   2. Contractor shall include in their bid a second training to occur (6) months after occupancy of building by the Owner. The second training shall be a minimum of (4) hours.

END OF SECTION 26 09 43

This page intentionally left blank

SECTION 26 22 00

LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
   1. Distribution transformers.
   2. Buck-boost transformers.

1.02 ACTION SUBMITTALS

A. Product Data: Manufacturer's technical data including rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated. Include manufacturer's product data for each type of transformer and for each size specified. Highlight clearly specific information applicable to the project. Submittals with general catalogs will not be accepted and reviewed.
   1. K.V.A. and voltage of primary and secondary windings.
   2. Windings insulation class and rates temperature rise.
   3. Underwriters' Laboratories, Inc. (U.L.) label.
   4. Sound level test results of a similar transformer.
   5. Physical size and finish.
   6. Efficiency at 25, 50, 75 and 100 percent rated load.
   7. Windings material.
   8. Factory test report of ratio and polarity test.
   9. Factory test report of applied voltage test.
   10. Factory test report of induced voltage test.
   11. Factory test report of temperature rise at full load.
   12. Impedance rating and characteristics.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Wiring Diagrams: Power, signal, and control wiring.

1.03 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Qualification Data: For testing agency.

C. Source quality-control test reports.

D. Field quality-control test reports.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. If alternate manufacturer of products other than what are specified in this section are submitted, all necessary documents not limited to cut sheets, technical information, test reports from recognized testing labs and factory test reports shall be submitted to the satisfaction of the Contracting Agency/engineer to ensure quality and conformance to the specifications. Additional testing shall be undertaken if it is concluded by the Contracting Agency/engineer that the submitted test reports are either insufficient or do not include all tests necessary for product acceptance. The tests shall be conducted by a recognized lab acceptable to the Contracting Agency/engineer and all tests shall be witnessed by Contracting Agency's/engineer's personnel. All testing procedures and test results shall be satisfactory to the Contracting Agency/engineer. Contractor shall be responsible for arranging the tests, for transportation, food and lodging for minimum of one Contracting Agency's/engineer's representative to witness the test at the testing lab. Include all costs for the above in the bid.

B. Contractor shall ensure that the manufacturer has a minimum of 15 years experience in the production of low voltage transformers to the type and size specified in this project.

C. Manufacturer shall have ISO 9001 Certification.

D. Manufacturer shall have ability to readily provide replacement parts for a minimum period of ten (10) years, from the date of completion of the project

E. Transformer shall be assembled at the manufacturer's own manufacturing facility using its own major devices (e.g. transformer core, windings etc.) for the assembly.

F. Materials and equipment shall be new, modern in design and shall not have been in prior service except as required by factory tests. Major components (e.g., primary switch, transformer, and switchboard) shall be manufactured within six months of installation.

G. Source Limitations: Obtain transformers through one source from a single manufacturer through a local distributor. All power distribution equipment shall be of the same manufacturer as the substation.

H. Comply with NFPA 70.

I. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

J. Product Options: Drawings indicate size, profiles, and dimensional requirements of secondary unit substations and are based on the specific system indicated. Refer to Part 2 "Product Requirements."

K. Electrical Components, Devices and Accessories: UL Listed and labeled as defined in NFPA 70, Article 100 and marked for intended use.

L. Testing Agency Qualifications:
   1. Testing agency shall be an independent company with the experience to conduct field testing as indicated; shall have been a member of Inter-National Testing Association (NETA) for a minimum of last ten (10) years.
   2. The company shall have permanent in-house testing engineers and technicians.
   3. Testing company shall be located with 50 miles radius of the project.
   4. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing to supervise on-site testing specified in Part 3.
   5. Field Testing technician and supervisor shall have minimum ten (10) years' experience in field testing of unit substations similar to the type and rating specified on this project.

M. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.07 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Square D; Schneider Electric.
   2. Eaton Electrical Inc.; Cutler-Hammer Products.
   3. General Electric Company; ABB
   4. Siemens Energy & Automation, Inc.

2.02 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: High grade, non-aging. grain-oriented, non-aging silicon steel. l with high magnetic permeability, and low hysteresis and eddy current losses. The core of the transformer shall be visibly grounded to the enclosure by means of flexible grounding conductor sized in accordance with applicable UL and NEC standard.

C. Coils: Continuous windings without splices except for taps.
   1. Internal Coil Connections: Brazed or pressure type.
   2. Coil material: Copper. Basic Insulation Level (BIL) for all 600V class windings shall be 10KV.

2.03 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.
   1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Enclosure: Ventilated, NEMA 250, Type 3.
   1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
   2. Shall be fabricated of heavy gauge, sheet steel construction.
   3. All ventilated openings shall be protected against falling dirt.
   4. Ventilated, raintight, NEMA 250, Type 3R, stainless steel. Provide suitable weather shields over ventilation openings.
   5. Provide rodent screen on front opening of the transformer.

F. Transformer Enclosure Finish: Comply with NEMA 250.
   1. Finish Color: ANSI 49 gray. The enclosure shall be finished utilizing a continuous process of degreasing, cleaning and phosphatizing followed by electrostatic deposition of polyester powder coating and baking.

G. Taps for Transformers Smaller Than 3 kVA: None.

H. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

~~I.~~ Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

J. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature. The maximum temperature of the top of the enclosure shall not exceed 50□C rise above a 40□C ambient.

K. Energy Efficiency for Transformers Rated 15 kVA and Larger:
   1. Comply with DOE 10 CFR Part 431 Appendix A of Subpart K 2016.
   2. Energy efficiency under DOE 2016 requirements is to be Energy Verified by UL.

L. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor. K factor shall not exceed 4, 13 or 20. K factor shall be as listed on the drawings.
   1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
   2. Indicate value of K-factor on transformer nameplate.

M. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
   1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
   2. Include special terminal for grounding the shield.
   3. Shield Effectiveness:
      a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
      b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
      c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

N. Wall Brackets: Manufacturer's standard brackets.

O. Fungus Proofing: Permanent fungicidal treatment for coil and core.

P. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.04 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 26 05 53 "Identification for Electrical Systems."

2.05 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91 at the factory prior to shipping to job site.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

C. Prepare and submit test report indicating actual test data within two (2) weeks of completion of tests prior to shipping to job site. Test report shall be signed by the factory test technician or engineer and include comments by the testing engineer or supervisor. Include their name, date and location

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems."

C. Transformers shall be installed at least six (6) inches from the adjacent wall or structure unless otherwise required by the manufacturer. Verify with manufacturer’s installation instructions before start of work.

D. All conduits shall be isolated from the transformer enclosures by the use of neoprene grommets at conduit entrances to enclosure and the use of a grounding bushing. Flexible jumpers shall be installed for grounding continuity from enclosure to conduits or bus ducts.

E. Where primary feeders come from the floor below, they shall terminate at the end of transformer enclosure with a metal grounding bushing with neoprene throat insert. Ground the bushing to the transformer enclosure.

F. Where primary feeders come from overhead, the conduits shall enter the side of the transformer enclosure. The conduits within 36 inches of the enclosure shall be flexible steel.

G. Where transformers are installed next to an indoor switchboard, secondary conductors shall be routed from transformer to secondary switchboard through a 12-inch long wiring gutter, flanged and bolted to transformer enclosure and switchboard enclosure. Install a neoprene gasket between gutter and transformer enclosure and bond gutter to transformer enclosure with a flexible copper grounding strap.

3.03 CONNECTIONS

A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

E. Remove and replace units that do not pass tests or inspections and retest as specified above.

F. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
   1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
   2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.

3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

G. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.05 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.06 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 22 00

SECTION 26 24 13

SWITCHBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Service and distribution switchboards rated 600 V and less and between 800A to 2000A.

B. Surge Protective Devices (SPD).

C. Disconnecting and overcurrent protective devices.

D. Instrumentation.

E. Control power.

F. Accessory components and features.

G. Identification.

H. Mimic bus is not common for switchboards other than large, drawout-type switchboards; it is normally used for switchgear construction.

I. Mimic bus.

J. Switchboard shall be front aligned.

1.02 RELATED REQUIREMEMTS

A. Section 26 05 26 “Grounding and Bonding for Electrical Systems”.

B. Section 26 05 36 “Cable Tray for Electrical Systems”.

C. Section 26 05 48 “Vibration and Seismic Controls for Electrical Systems”

D. Section 26 05 53 “Identification for Electrical Systems”.

E. Section 26 05 73 "Short Circuit, Coordination and Arc Flash Studies" for short-circuit rating of devices and for setting of overcurrent protective devices.

F. Section 26 09 13 "Electrical Power Monitoring and Control" for communication features of power distribution system devices.

G. Section 26 25 00 "Enclosed Bus Assemblies" for busway connections between transformers and secondary distribution equipment.

H. Section 26 36 00 "Transfer Switches" for transfer switches that may be located in secondary distribution section.

I. Section 26 43 13 "Surge Protection for Low-Voltage Electrical Power Circuits" for transient voltage surge suppressors for low-voltage power, control, and communication equipment that may be located in secondary section.

1.03 DEFINITIONS

A. NETA ATS: InterNational Electrical Testing Association - Acceptance Testing Specification.

B. EMI: Electromagnetic interference.

C. GFCI: Ground-fault circuit interrupter.

D. RFI: Radio-frequency interference.

E. RMS: Root mean square.

F. SPDT: Single pole, double throw.

G. AIC: Interrupting capacity (RMS symmetrical) in amperes.

1.04 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Component Importance Factor: 1.0.
   3. Component Amplification Factor: 2.5.
   4. Component Response Modification Factor: 6.0.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details, including required horizontal and vertical clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
   5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
   6. Detail utility company's metering provisions with indication of approval by utility company.
   7. Include evidence of NRTL listing for series rating of installed devices. Series rated devices shall be provided if specified on the drawings.
   8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
   10. Include diagram and details of proposed mimic bus.
   11. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Ceiling and floor plans, drawn to scale (1/4”=1”-0”), on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Show structural members e.g columns, beams, doors etc. within the area where switchboards are located.

B. Qualification Data: For qualified testing agency.

C. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
4. Submit within two (2) weeks of completion of tests.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 1-11 "Operation and Maintenance Data," include the following:
   1. Routine maintenance requirements for switchboards and all installed components.
   2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.08 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
   2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
   3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

1.09 QUALITY ASSURANCE

A. If alternate manufacturer of products other than what are specified in this section are submitted, all necessary documents not limited to cut sheets, technical information, test reports from recognized testing labs and factory test reports shall be submitted to the satisfaction of the Contracting Agency/engineer to ensure quality and conformance to the specifications. Additional testing shall be undertaken if it is concluded by the Contracting Agency/engineer that the submitted test reports are either insufficient or do not include all tests necessary for product acceptance. The tests shall be conducted by a recognized lab acceptable to the Contracting Agency/engineer and all tests shall be witnessed by Contracting Agency's/engineer's personnel. All testing procedures and test results shall be satisfactory to the Contracting Agency/engineer. Contractor shall be responsible for arranging the tests, for transportation, food and lodging for minimum of one Contracting Agency's/engineer's representative to witness the test at the testing lab. Include all costs for the above in the bid.

B. Contractor shall ensure that the manufacturer has a minimum of 15 years experience in the production of Switchboards similar to the type and size specified in this project.

C. Manufacturer shall have ISO 9001 or 9002 Certification.

D. Manufacturer shall have ability to readily provide replacement parts for a minimum period of ten (10) years, from the date of completion of the project. Furnish a letter from the manufacturer confirming the availability.

E. Switchboards shall be assembled at the manufacturer's own manufacturing facility using its own major devices (e.g., circuit breakers) for the assembly. These devices shall be normally carried by the manufacturer as standard catalog items.

F. Switchboard shall comply with seismic zone applicable to the project. Unless otherwise indicated, verify requirements with Architect or Structural Engineer of Record (SEOR). Provide certified test reports of shake table test done by manufacturer on similar units.

G. Materials and equipment shall be new, modern in design and shall not have been in prior service except as required by factory tests. Major components (e.g., primary switch, transformer, and switchboard) shall be manufactured within six months of installation.

H. Source Limitations: Obtain switchboards, overcurrent protective devices and accessories through one source from a single manufacturer through a local distributor unless otherwise indicated. All power distribution equipment shall be of the same manufacturer as the substation.

I. Comply with NEMA PB 2.

J. Comply with NFPA 70.

K. Comply with UL 891.

L. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

M. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchboards and are based on the specific system indicated. Refer to Part 2 "Product Requirements."

N. Electrical Components, Devices, and Accessories: NRTL Listed and labeled as defined in NFPA 70, Article 100 and marked for intended location and application.

O. Testing Agency Qualifications: Member of NETA;
   1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of ten (10) years and has permanent in-house testing engineers and technicians involved with testing of switchboards and OCPDs similar to those specified on this project.
   2. Testing company shall be located with 50 miles radius of the project.
   3. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing to supervise on-site testing specified in Part 3.
   4. Field Testing technician and supervisor shall have minimum ten (10) years experience in field testing of switchboards similar to the type and rating specified on this project.

P. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products in accordance with manufacturer's recommended practices and as listed in Installation and Maintenance Manual.

B. Each switchboard section shall be shipped in individual shipping splits for ease of handling. They shall be mounted on shipping skids and individually wrapped.

C. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path at site.

D. Inspect and report damage to carrier within their required time period.

E. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

F. If stored in areas subjected to weather, cover switchboards to provide protection from weather, dirt, dust, corrosive substances, and physical damage.

G. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) connect factory-installed space heaters to temporary electrical service to prevent condensation.

H. Handle and prepare switchboards for installation according to NECA 400 NEMA PB 2.1.

1.11 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:
   1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
   2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
      b. Altitude: Not exceeding 6600 feet (2000 m).

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:
   1. Ambient temperatures within limits specified.
   2. Altitude not exceeding 6600 feet (2000 m).

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Contracting Agency or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Construction Manager no fewer than fourteen (14) days in advance of proposed interruption of electric service.
   2. Do not proceed with interruption of electric service without Construction Manager's written permission.
   3. All utility shutdowns will be done by Contracting Agency’s authorized personnel unless otherwise noted. Coordinate through Contracting Agency.
   4. Comply with NFPA 70E.
   5. Provide temporary standby power through a standby diesel quiet type back-up generator complete with fuel and 7/24 monitoring if the existing service interruption exceeds 2 hours. Coordinate additional requirements with Contracting Agency minimum fourteen days in advance. Indicate method of providing temporary electric service.

1.12 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.13 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SURGE PROTECTION DEVICES that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Square D; a brand of Schneider Electric
   2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
4. Siemens Energy & Automation, Inc.
5. ABB

C. Front-Connected, Front-Accessible Switchboards:
1. Main Devices: Fixed, individually mounted unless otherwise indicated.
2. Branch Devices: Panel mounted for sizes up to 400A.
3. Sections front and rear aligned.

D. Front- and Side-Accessible Switchboards:
1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted for sizes up to 400A.
3. Sections front and rear aligned.

E. Front- and Rear-Accessible Switchboards:
1. Main Devices: Drawout mounted if indicated on the drawings.
2. Branch Devices: Fixed and individually compartmented mounted.
3. Sections: front aligned.

F. Nominal System Voltage: see single line diagram.

G. Main-Bus Continuous: see single line diagram

H. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."

I. Indoor Enclosures: Steel, NEMA 250, Type 1.

J. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

K. Outdoor Enclosures: Type 3R.
1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
2. Enclosure: Downward, rearward sloping roof; rear hinged doors for each section, with provisions for padlocking.
3. Doors: Personnel door at each end of aisle, minimum width of 30 inches (762 mm); opening outwards; with panic hardware and provisions for padlocking.
4. Accessories: Fluorescent lighting fixtures, ceiling mounted; wired to a three-way light switch at each end of aisle; ground-fault circuit interrupter (GFCI) duplex receptacle; emergency battery pack lighting fixture installed on wall of aisle midway between personnel doors. Battery pack shall be manufactured by “Bodine” and provide minimum 1100 lumens in emergency mode.
5. Walk-in Aisle Heating and Ventilating:
   a. Factory-installed electric unit heater(s), wall or ceiling mounted, with integral thermostat and disconnect and with capacities to maintain switchboard interior temperature of 40 deg F (5 deg C) with outside design temperature of 104 deg F (40 deg C).
   b. Factory-installed exhaust fan with capacities to maintain switchboard interior temperature of 100 deg F (38 deg C) with outside design temperature of 23 deg F (minus 5 deg C).
   c. Ventilating openings complete with replaceable fiberglass air filters.
   d. Thermostat: Single stage; wired to control heat and exhaust fan.
6. Power for Space Heaters, Ventilation, Lighting, and Receptacle: Include a control-power transformer within the switchboard. Supply voltage shall be 120-V ac.
7. Power for space heaters, ventilation, lighting, and receptacle provided by a remote source. Verify if a remote source is available nearby.

L. Barriers: Between adjacent switchboard sections.

M. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

N. Cubicle Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point. Provide in all switchboards located outdoors, other areas with high humidity and switchboards located indoors in coastal areas.
   1. Space-Heater Control: Thermostats and a humidistat connected in parallel to maintain temperature and humidity of each section above expected dew point.
   2. Space-Heater Power Source: 120-V external branch circuit if available from a nearby branch circuit panel.
   3. For switchboards connected to emergency power, provide 120V (or 208 V) branch circuit to the space heaters from a local emergency power branch circuit panel. Circuit shall terminate at a factory installed disconnect switch located near the heaters in compliance with NEC. Control of heaters shall be through a thermostat and humidistat connected in parallel.

O. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

P. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks. For switchboards with space heaters, provide CTs ahead of the main so that power used by the space heaters is recorded by the meter too.

Q. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

R. Removable, Hinged Rear Doors and Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.

S. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

T. Pull Box on Top of Switchboard:
   1. Provide a proper size (per NEC) pull box on the top of the switchboard.
   2. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
   3. Set back from front to clear circuit-breaker removal mechanism.
   4. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
   5. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
   6. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

U. Buses and Connections: Three phase, four wire unless otherwise indicated.
   1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, or copper feeder circuit-breaker line connections.
   2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity
   3. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
   4. Ground Bus: 1/4-by-1-inch- (6-by-25-mm-) hard-drawn copper of 98 percent conductivity, equipped with compression connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

5. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
6. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
7. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

V. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

W. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

X. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.02 SURGE PROTECTIVE DEVICES (SPD)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
1. Square D; a brand of Schneider Electric.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
4. Siemens Energy & Automation, Inc.

B. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, bolt-on, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:
1. Fuses rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral disconnect switch.
4. Redundant suppression circuits.
5. Redundant replaceable modules.
6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.
9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
10. 4-digit, transient-event counter set to totalize transient surges.

C. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.

D. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

E. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277V and 208Y/120, three-phase, four-wire circuits shall be as follows:
1. Line to Neutral: 800 V for 480Y/277 and 400 V for 208Y/120.
2. Line to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.
3. Neutral to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.

F. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:
1. Line to Neutral: 400 V, 800 V from high leg.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

2.03 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity (AIC) to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; field replaceable and the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response.
   4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
   6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
   7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
      a. Standard frame sizes, trip ratings, and number of poles.
      b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.
      c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
      d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
      e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
      f. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Section 26 09 13 "Electrical Power Monitoring and Control."
      g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
      h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
      i. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
      j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

B. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
   1. Fixed circuit-breaker mounting.
   2. Two-step, stored-energy closing.
   3. Standard function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time time adjustments.
      c. Ground-fault pickup level, time delay, and I^2t response.
   4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
   5. Remote trip indication and control.

6. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Section 26 09 13 "Electrical Power Monitoring and Control."
7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
8. Control Voltage: 120-V ac.

C. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
a. Square D; a brand of Schneider Electric
b. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
c. Pringle Electrical Manufacturing Company, Inc.
d. Siemens Energy & Automation, Inc.
e. Boltswitch, Inc.
2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.
a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
4. Auxiliary Switches: Factory installed, single pole, double throw, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
5. Service-Rated Switches: Labeled for use as service equipment.
6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.

D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

E. Fuses are specified in Section 26 28 13 "Fuses."

2.04 INSTRUMENTATION

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, tapped secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; wound type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
   1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
      a. Phase Currents, Each Phase: Plus or minus 1 percent.
      b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
      c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
      d. Megawatts: Plus or minus 2 percent.
      e. Megavars: Plus or minus 2 percent.
      f. Power Factor: Plus or minus 2 percent.
      g. Frequency: Plus or minus 0.5 percent.
      h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
      i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
      j. Contact devices to operate remote impulse-totalizing demand meter.
   2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
   3. Digital Meter shall be manufactured by the one following manufacturers: Square D; Eaton-Cutler Hammer.

C. Ammeters, Voltmeters, and Power-Factor Meters: ANSI C39.1.
   1. Meters: 4-inch (100-mm) diameter or 6 inches (150 mm) square, flush or semiflush, with antiparallax 250-degree scales and external zero adjustment.
   2. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.

D. Instrument Switches: Rotary type with off position.
   1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.
   2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.

E. Feeder Ammeters: 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale. Meter and transfer device with off position, located on overcurrent device door for indicated feeder circuits only.

F. Watt-Hour Meters and Wattmeters:
   1. Comply with ANSI C12.1.
   2. Three-phase induction type with two stators, each with current and potential coil, rated 5 A, 120 V, 60 Hz.
   3. Suitable for connection to three- and four-wire circuits.
   4. Potential indicating lamps.
   5. Adjustments for light and full load, phase balance, and power factor.
   6. Four-dial clock register.
   7. Integral demand indicator.
   8. Contact devices to operate remote impulse-totalizing demand meter.
   9. Ratchets to prevent reverse rotation.
   10. Removable meter with drawout test plug.
   11. Semiflush mounted case with matching cover.
   12. Appropriate multiplier tag.

G. Impulse-Totalizing Demand Meter:
   1. Comply with ANSI C12.1.
   2. Suitable for use with switchboard watt-hour meter, including two-circuit totalizing relay.
   3. Cyclometer.
   4. Four-dial, totalizing kilowatt-hour register.
   5. Positive chart drive mechanism.
   6. Capillary pen holding a minimum of one month's ink supply.

7. Roll chart with minimum 31-day capacity; appropriate multiplier tag.
8. Capable of indicating and recording 15-minute integrated demand of totalized system.

2.05 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

B. Control Circuits: 120-V ac, supplied from remote branch circuit.

C. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.

D. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

E. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.06 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

C. Portable Circuit-Breaker Lifting Device: Floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers. Provide a factory manufactured separate full height section as part of switchboard lineup for storage of the portable device.

D. Overhead Circuit-Breaker Lifting Device: Mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker. Provide overhead type of device unless otherwise indicated. Verify adequate clearances are available around the switchboard for proper operation of the device and removal of the circuit breaker from the switchboard. Engineer to specify either portable or overhead lifting device.

E. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

2.07 IDENTIFICATION

A. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram. Mimic bus name plate shall be at least 0.0625-inch- (1.588 mm-) thick laminated plastic (Gravoply) located at eye level on front cover of the switchboard.

B. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

C. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.

D. Service Equipment Label: UL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 EXECUTION

3.01 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NECA 400 NEMA PB 2.1.

B. Examine switchboards before installation to verify compliance with approved shop drawings. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected to the satisfaction of the Contracting Agency.

3.02 INSTALLATION

A. Install switchboards and accessories according to NECA 400 NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
   2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Comply with mounting and anchoring requirements specified in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, surge protection devices, and instrumentation.
   1. Set field-adjustable switches and circuit-breaker trip ranges in accordance with the recommendations of the Overcurrent Protective Device Short Circuit, Coordination and Arc Flash Study.

H. Install spare-fuse cabinet.

I. Comply with NECA 1.

3.03 CONNECTIONS

A. Comply with requirements for terminating feeder bus specified in Section 26 25 00 "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

B. Comply with requirements for terminating cable trays specified in Section 26 05 36 "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.04 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting, and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, start-up and to assist in testing.

C. Acceptance Testing Preparation:
   1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

D. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. All tests shall be witnessed by Contracting Agency. Provide minimum fourteen (14) days advance notice.
   3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   4. Perform the following infrared scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front and rear panels so joints and connections are accessible to portable scanner.
      b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
      c. Instruments and Equipment:
         1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Switchboard will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

3.07 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.08 DEMONSTRATION

A. Engage a factory-authorized service representative to train Contracting Agency's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 26 24 13

SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Distribution panelboards.

B. Lighting and appliance branch-circuit panelboards.

1.02 RELATED REQUIREMENTS

A. Section 26 05 53 “Identification for Electrical Systems”.

B. Section 26 05 73 "Overcurrent Protective Device Coordination Study" for short-circuit rating of devices and for setting of overcurrent protective devices.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RMS: Root mean square.

D. SPDT: Single pole, double throw

E. SPD: Surge Protective Device

1.04 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.05 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of ~~UL~~ NRTL listing for series rating of installed devices. Series rated devices shall be permitted if specified on the drawings.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field Quality-Control Reports:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
   4. Submit within two (2) weeks of completion of tests.

D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.08 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Keys: 2 spares for each type of panelboard cabinet lock.
   2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: 2 spares for each panelboard.
   3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.09 QUALITY ASSURANCE

A. If alternate manufacturer of products other than what are specified in this section are submitted, all necessary documents not limited to cut sheets, technical information, test reports from recognized testing labs and factory test reports shall be submitted to the satisfaction of the Contracting Agency/engineer to ensure quality and conformance to the specifications. Additional testing shall be undertaken if it is concluded by the Contracting Agency/engineer that the submitted test reports are either insufficient or do not include all tests necessary for product acceptance. The tests shall be conducted by a recognized lab acceptable to the Contracting Agency/engineer and all tests shall be witnessed by Contracting Agency's/engineer's personnel. All testing procedures and test results shall be satisfactory to the Contracting Agency/engineer. Contractor shall be responsible for arranging the tests, for transportation, food and lodging for minimum of one Contracting Agency's/engineer's representative to witness the test at the testing lab. Include all costs for the above in the bid.

B. Contractor shall ensure that the manufacturer has a minimum of 15 years experience in the production of Panelboards similar to the type and size specified in this project.

C. Manufacturer shall have ISO 9001 or 9002 Certification.

D. Manufacturer shall have ability to readily provide replacement parts for a minimum period of ten (10) years, from the date of completion of the project. Furnish a letter from the manufacturer confirming the availability.

E. Panelboards shall be assembled at the manufacturer's own manufacturing facility using its own major devices (e.g., circuit breakers) for the assembly. These devices shall be normally carried by the manufacturer as standard catalog items.

F. Panelboard shall comply with seismic zone applicable to the project. Unless otherwise indicated, verify requirements with Architect or Structural Engineer of Record (SEOR). Provide certified test reports of shake table test done by manufacturer on similar units as applicable for OSHPD projects.

G. Materials and equipment shall be new, modern in design and shall not have been in prior service except as required by factory tests. Major components (e.g. Circuit breakers) shall be manufactured within six months of installation.

H. Source Limitations: Obtain panelboards, overcurrent protective devices and accessories through one source from a single manufacturer through a local distributor unless otherwise indicated. All power distribution equipment shall be of the same manufacturer as the substation.

I. Comply with NFPA 70.

J. Comply with NEMA PB 1.

K. Comply with UL 891.

L. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

M. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Part 2 "Product Requirements."

N. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70, Article 100—and marked for intended location and application.

O. Testing Agency Qualifications: Member of NETA;
   1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of ten (10) years and has permanent in-house testing engineers and technicians involved with testing of switchboards, panelboards and OCPDs similar to those specified on this project.
   2. Testing company shall be located with 50 miles radius of the project.
   3. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing to supervise on-site testing specified in Part 3.
   4. Field Testing technician and supervisor shall have minimum ten (10) years experience in field testing of switchboards similar to the type and rating specified on this project.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407 NEMA PB 1.

1.11 PROJECT CONDITIONS

A. Environmental Limitations:
   1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
   2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).

b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Contracting Agency or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Construction Manager no fewer than 2 days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Construction Manager's written permission.
3. Comply with NFPA 70E.

1.12 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.13 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets.
1. Rated for environmental conditions at installed location.
a. Indoor Dry and Clean Locations: NEMA 250, Type 1
b. Outdoor Locations: NEMA 250, as indicated on plans
c. Wash-Down Areas: NEMA 250, as indicated on plans
d. Other Wet or Damp Indoor Locations: NEMA 250, as indicated on plans
e. Dusty or hazardous environment – Panelboard suitable for duty or hazardous environment
2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor. No splices shall be permitted inside the skirt.
5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections. No splices shall be permitted inside gutters.
6. Finishes:

a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat or Powder coated
b. Back Boxes: Same finish as panels and trim.
c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
5. Split Bus: Vertical buses divided into individual vertical sections.

E. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Compression type.
3. Ground Lugs and Bus-Configured Terminators: Compression type.
4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard shall be listed and labeled with UL short circuit rating. If Series Rated Panelboard is specified-the panelboard shall be rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.02 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers
1. Square D; a brand of Schneider Electric.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
4. Siemens Energy & Automation, Inc.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Interiors shall be completely factory assembled. These shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus interiors.

D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

E. Mains: Circuit breaker.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

G. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

H. Branch Overcurrent Protective Devices: Fused switches.

I. Where indicated, provide circuit breakers UL listed for application at 100% of their continuous ampere rating in their intended enclosure.

J. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
   1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
   2. External Control-Power Source: 120-V branch circuit

K. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.03 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers
   1. Square D; a brand of Schneider Electric
   2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   4. Siemens Energy & Automation, Inc.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
   1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
   2. External Control-Power Source: 120-V branch circuit

F. Doors: Door-in-door type. Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.04 LOAD CENTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers
   1. Square D; a brand of Schneider Electric
   2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   4. Siemens Energy & Automation, Inc..

B. Load Centers: Comply with UL 67.

C. Mains: Circuit breaker.

D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

E. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.05 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers
   1. Square D; a brand of Schneider Electric.
   2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   4. Siemens Energy & Automation, Inc..

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
   1. Where indicated provide circuit breakers UL listed for application at 100% of their continuous ampere rating in their intended enclosure.
   2. Thermal-Magnetic Circuit Breakers (below 400A frame): Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Provide field adjustable magnetic trip setting for circuit-breakers serving motor loads or other special applications as indicated
   3. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   4. Electronic trip circuit breakers (400A frame size and larger) with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response.
      e. CBs shall have an integral power supply installed at the factory if required for proper functioning of the breaker. An external power supply shall not be acceptable.
   5. Circuit breakers shall have a minimum interrupting rating of 10,000 amperes RMS symmetrical at 240 volts, and 14,000 amperes RMS symmetrical at 480 volts, unless otherwise noted on the drawings. Verify maximum available fault levels from the Short Circuit and Coordination Study. Minimum interrupting rating (AIC) shall be 110% of the available fault level.
   6. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   7. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
   8. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
   9. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
   10. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
      a. Standard frame sizes, trip ratings, and number of poles.
      b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
      c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
      d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
      e. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Section 26 09 13 "Electrical Power Monitoring and Control."
      f. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
h. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
i. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
k. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
l. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
n. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
o. Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Section 26 28 13 "Fuses."
2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
3. Auxiliary Contacts: Two normally open and normally closed contact(s) that operate with switch handle operation.

2.06 PANELBOARD SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers
1. Square D; a brand of Schneider Electric
2. Current Technology; a subsidiary of Danahar Corporation.
3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
5. Siemens Energy & Automation, Inc..

B. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, non-modular type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:
1. Accessories:
a. LED indicator lights for power and protection status.
b. Audible alarm, with silencing switch, to indicate when protection has failed.
c. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.

C. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, bolt-on, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:
1. Accessories:
a. Fuses rated at 200-kA interrupting capacity.
b. Fabrication using bolted compression lugs for internal wiring.
c. Integral disconnect switch.
d. Redundant suppression circuits.
e. Redundant replaceable modules.
f. Arrangement with wire connections to phase buses, neutral bus, and ground bus.

g. LED indicator lights for power and protection status.
h. Audible alarm, with silencing switch, to indicate when protection has failed.
i. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
j. Four-digit, transient-event counter set to totalize transient surges.

2. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.
3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.
   a. Line to Neutral: 70,000 A.
   b. Line to Ground: 70,000 A.
   c. Neutral to Ground: 70,000 A.
4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
5. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277, 208Y/120, three-phase, four-wire circuits shall be as follows:
   a. Line to Neutral: 800 V for 480Y/277 or 400 V for 208Y/120
   b. Line to Ground: 800 V for 480Y/277 or 400 V for 208Y/120
   c. Neutral to Ground: 800 V for 480Y/277 or 400 V for 208Y/120
6. Protection modes and UL 1449 SVR for 240/120-V, single-phase, three-wire circuits shall be as follows:
   a. Line to Neutral: 400 V.
   b. Line to Ground: 400 V.
   c. Neutral to Ground: 400 V.
7. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:
   a. Line to Neutral: 400 V, 800 V from high leg.
   b. Line to Ground: 400 V.
   c. Neutral to Ground: 400 V.
8. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:
   a. Line to Line: 2000 V for 480 V and 1000 V for 240 V.
   b. Line to Ground: 1500 V for 480 V 800 V for 240 V.

2.07 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 EXECUTION

3.01 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
   2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to panelboards.
   5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."

E. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated. Mounting height of Over Current Protective Devices shall be 6”7” above finished floor to the center of the grip of device operating handle unless a lower height is indicated or required by code.

F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Install overcurrent protective devices and controllers not already factory installed.
   1. Set field-adjustable, circuit-breaker trip ranges.

H. Install filler plates in unused spaces.

I. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

K. Comply with NECA 1.

3.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 05 53 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Contracting Agency's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
   c. Instruments and Equipment:
      1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable component to function smoothly and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.06 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

This page intentionally left blank

SECTION 26 25 00
ENCLOSED BUS ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Feeder-bus assemblies.

B. Plug-in bus assemblies.

C. Bus plug-in devices.

1.02 DEFINITIONS

A. kAIC: kiloampere interrupting capacity.

B. SPD: Surge protective device.

1.03 ACTION SUBMITTALS

A. Shop Drawings: For each type of product.
   1. Show fabrication and installation details for enclosed bus assemblies. Include plans, elevations, and sections of components. Designate components and accessories, including clamps, brackets, hanger rods, connectors, straight lengths, and fittings.
   2. Show fittings, materials, fabrication, and installation methods for listed firestop barriers.
   3. Indicate required clearances, method of field assembly, and location and size of each field connection.
   4. Detail connections to switchgear, switchboards, transformers, and panelboards.
   5. Cable and conductor terminal sizes for bus and plug-in device terminations.
   6. Wiring Diagrams: Power wiring.

B. Delegated-Design Submittal: For seismic-restraint details, signed and sealed by a qualified professional engineer.
   1. Include design calculations for selecting seismic restraints.
   2. Detail fabrication, including anchorages and attachments to structure and to supported equipment.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and sections, drawn to scale. Include scaled bus-assembly layouts and relationships between components and adjacent structural, mechanical, and electrical elements. Show the following:
   1. Vertical and horizontal enclosed bus-assembly runs, offsets, and transitions.
   2. Clearances for access above and to the side of enclosed bus assemblies.
   3. Vertical elevation of enclosed bus assemblies above the floor or bottom of structure.
   4. Support locations, type of support, and weight on each support.
   5. Location of adjacent construction elements including luminaires, HVAC and plumbing equipment, fire sprinklers and piping, signal and control devices, and other equipment.

B. Qualification Data: For testing agency.

C. Seismic Qualification Certificates: For enclosed bus assemblies, plug-in devices, accessories, and components.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed bus assemblies to include in emergency, operation, and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Plug-in Units: 10 percent of amount installed, but no fewer than 3 unit(s).

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle enclosed bus assemblies according to NEMA BU 1.1, "General Instructions for Handling, Installation, Operation, and Maintenance of Busway Rated 600 Volts or Less."

PART 2 PRODUCTS

2.01 ASSEMBLY DESCRIPTIONS

A. Source Limitations: Obtain enclosed bus assemblies and plug-in devices from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 857.

2.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineerto design enclosed bus assemblies, plug-in devices, and components.

B. Seismic Performance: Enclosed bus assemblies, plug-in devices, and components shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Component Importance Factor: 1.5.

C. Derate enclosed bus assemblies for continuous operation at indicated ampere ratings for ambient temperature not exceeding 122 deg F (50 deg C).

2.03 ENCLOSED BUS ASSEMBLIES

A. Feeder-Bus Assemblies: Low-impedance bus assemblies in totally enclosed, nonventilated housing; single-bolt joints; ratings as indicated.
   1. Seismic Fabrication Requirements: Fabricate mounting provisions and attachments for feeder-bus assemblies with reinforcement strong enough to withstand seismic forces defined in Section 26 05 48.16 "Seismic Controls for Electrical Systems" when mounting provisions and attachments are anchored to building structure
   2. Electrical Characteristics:
      a. Voltage: 277/480 V.
      b. Phase: Three; 4 wire.
      c. Percent of Neutral Capacity: 100
   3. Short-Circuit Interrupting Rating:
      a. For Bus Amperage of 800: 85 symmetrical kAIC.
      b. For Bus Amperage of 1200: 100 symmetrical kAIC.
      c. For Bus Amperage of 1600: 125 symmetrical kAIC.
      d. For Bus Amperage of 2500: 150 symmetrical kAIC.

e. For Bus Amperage of 5000: 200 symmetrical kAIC.

4. Temperature Rise: 55 deg C above 40 deg C ambient maximum for continuous rated current.
5. Bus Materials: Current-carrying copper conductors, fully insulated with Class 130C insulation except at joints; plated surface at joints.
6. Voltage Drop:
   a. Measure voltage drop at 30 deg C ambient with bus thermally stabilized at full rated load.
   b. Three-phase, line-to-line voltage drop less than 3.1 V per 100 feet (30.5 m) at 40 percent power factor.
7. Ground: 50 percent capacity, integral with housing.
8. Ground: 50 percent capacity, internal bus bar of material matching bus material.
9. Ground: 50 percent capacity, isolated, internal bus bar of material matching bus material.
10. Enclosure: Steel, with manufacturer's standard finish.
11. Fittings and Accessories: Manufacturer's standard.
12. Firestop: Comply with UL 1479 firestop system, listed and labeled by an NRTL acceptable to authorities having jurisdiction for penetrations of fire-rated walls, ceilings, and floors.
13. Mounting: Arranged flat, edgewise, or vertically without derating. Rated for hanger spacing of up to 10 feet (3 m) for horizontally mounted runs and up to 16 feet (5 m) for vertically mounted runs.
14. Expansion Section: Manufacturer's standard expansion fitting for the provided busway with expansion capability to accommodate thermal expansion of bus and enclosure, and to accommodate movement across building expansion joints.

B. Joints:
1. Busway joints shall use one high-strength steel bolt with Belleville washers.
2. Bolts shall be torque indicating type and at ground potential.
3. Bolts shall be two-headed design to indicate when proper torque has been applied and require only a standard long handle wrench to be properly activated.
4. Access shall be required to only one side of the busway for tightening joint bolts.
5. Joint connection assemblies shall be removable without disturbing adjacent busway lengths.
6. Joint connection assemblies that rely on the joint cover to provide ground continuity are unacceptable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Coordinate layout and installation of enclosed bus assemblies and suspension system with other construction that penetrates ceilings or floors or is supported by them, including luminaires, HVAC equipment, fire-suppression system, and partition assemblies.

B. Equipment Mounting:
1. Install enclosed bus assemblies on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
2. Coordinate size and location of concrete curbs around openings for vertical bus. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Support bus assemblies independent of supports for other elements such as equipment enclosures at connections to panelboards and switchboards, pipes, conduits, ceilings, and ducts.
1. Design each fastener and support to carry load indicated by seismic requirements and to comply with seismic-restraint details according to Section 26 05 48.16 "Seismic Controls for Electrical Systems."
2. Design each fastener and support to carry 200 lb (90 kg) or 4 times the weight of bus assembly, whichever is greater.
3. Support bus assembly to prevent twisting from eccentric loading.

4. Support bus assembly with not less than 3/8-inch (10-mm) steel rods. Install side bracing to prevent swaying or movement of bus assembly. Modify supports after completion to eliminate strains and stresses on bus bars and housings.
5. Fasten supports securely to building structure according to Section 26 05 29 "Hangers and Supports."
6. Bolts and nuts that are loosened for any reason after tightening to manufacturer's recommended torque setting shall be discarded and replaced with new bolts and nuts.

D. Install expansion fittings at locations where bus assemblies cross building expansion joints. Install at other locations so distance between expansion fittings does not exceed manufacturer's recommended distance between fittings.

E. Construct rated firestop assemblies where bus assemblies penetrate fire-rated elements such as walls, floors, and ceilings. Seal around penetrations according to Section 07 84 00 " Firestopping."

F. Install weatherseal fittings and flanges where bus assemblies penetrate exterior elements such as walls or roofs. Seal around openings to make weathertight. See Section 07 92 00 "Joint Sealants" for materials and application.

G. Coordinate bus-assembly terminations to equipment enclosures to ensure proper phasing, connection, and closure.

H. Tighten bus-assembly joints with torque wrench or similar tool recommended by bus-assembly manufacturer. Tighten joints again after bus assemblies have been energized for 30 days.

I. Install bus-assembly, plug-in units. Support connecting conduit independent of plug-in unit.

J. Comply with NECA 1.

3.02 CONNECTIONS

A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Terminate to transformer enclosures with matching bus assemblies according to Section 26 22 00 "Low-Voltage Transformers."

D. Terminate to switchboard enclosures with matching bus assemblies according to Section 26 24 13 "Switchboards."

E. Terminate to panelboard enclosures with matching bus assemblies according to Section 26 24 16 "Panelboards."

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Contracting Agency will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
1. After installing equipment test, for compliance with requirements according to NETA ATS.
2. Visual and Mechanical Inspection:
   a. Compare equipment nameplate data with Drawings and Specifications.
   b. Inspect physical and mechanical condition.
   c. Inspect anchorage, alignment, and grounding.
   d. Verify correct connection according to single-line diagram.
   e. Inspect bolted electrical connections for high resistance using one or more of the following methods:
      1) Use of low-resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
3) Perform thermographic survey.

3. Electrical Tests:
   a. Perform insulation resistance measurements through bolted connections and bus joints with low-resistance ohmmeter.
   b. Perform insulation resistance tests of each busway, phase to phase, and phase to ground.
   c. Perform a dielectric withstand voltage test on each busway, phase to ground with phases not under test grounded for one minute.
   d. Measure resistance of assembled busway sections on insulated busway and compare values with adjacent phases.
   e. Perform phasing test on each busway tie section energized by separate sources.
   f. Verify operation of busway space heaters.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
   1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
   3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

F. Enclosed bus assemblies will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.04 ADJUSTING

A. Set field-adjustable, circuit-breaker trip ranges and overload relay trip settings as indicated.

3.05 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.06 PROTECTION

A. Provide final protection to ensure that moisture does not enter bus assembly.

END OF SECTION 26 25 00

This page intentionally left blank

SECTION 26 27 13
ELECTRICITY METERING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment for electricity metering by utility company and electricity metering by Contracting Agency.

1.02 DEFINITIONS

A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.

B. PC: Personal computer.

1.03 ACTION SUBMITTALS

A. Product Data: Manufacturer's technical data for each type of product indicated.

B. Shop Drawings: For electricity-metering equipment.
   1. Dimensioned plans and sections or elevation layouts.
   2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

C. Manufacturer Seismic Qualification Certification for Electricity-Metering Equipment: Submit certification that equipment components and their mounting and anchorage provisions have been designed to remain in place without separation of any parts or loosening of factory-made connections when subjected to the seismic forces and shall include the following:
   1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculations.
   2. Detailed description of equipment mounting and anchorage devices on which the certification is based and their installation requirements.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data. In addition to items specified in Section 1-11 "Operation and Maintenance Data," include the following:
   1. Application and operating software documentation.
   2. Software licenses.
   3. Software service agreement.
   4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70 and marked for intended location and application.

B. Contracting Agency's Meters in switchgear/switchboard/distribution board shall be installed by the manufacturer at the factory.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, store, and handle modular meter center according to NECA 400.

1.08 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Contracting Agency or others unless permitted in writing under the following conditions

and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager no fewer than fourteen (14) days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's written permission.
3. Comply with NFPA 70E.
4. Provide temporary standby power through a standby diesel quiet type back-up generator complete with fuel and 7/24 monitoring if the existing service interruption exceeds 2 hours. Coordinate additional requirements with Contracting Agency minimum fourteen days in advance. Indicate method of providing temporary electric service.

1.09 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
   1. Comply with requirements of utilities providing electrical power services.
   2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

1.10 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for 2 years from the date of acceptance of the project by the Contracting Agency.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software at no additional cost to the Contracting Agency.
   1. Provide 30 days' notice to Contracting Agency to allow scheduling and access to system and to allow Contracting Agency to upgrade his computer equipment if necessary.

PART 2 PRODUCTS

2.01 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Meters will be furnished by utility company.

B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.

C. Meter Sockets: Comply with requirements of electrical-power utility company.

D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

E. Modular Meter Center: Factory-coordinated assembly of a main service terminal box with lugs only, wireways, tenant meter socket modules, and tenant feeder circuit breakers arranged in adjacent vertical sections. Assembly shall be complete with interconnecting buses and other features as specified below.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
      a. Square D; a brand of Schneider Electric
      b. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
      c. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
      d. Siemens Energy & Automation, Inc..
      e. Electrotech Industries
      f. E-Mon; a division of Hunt Power.
   2. Comply with requirements of utility company for meter center.
      a. Comply with UL 67.
   3. Housing: NEMA 250, Type 3R enclosure.
   4. Minimum Short-Circuit Rating: 42,000 A symmetrical at rated voltage.

5. Main Disconnect Device: Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers.
6. Main Disconnect Device: Fusible switch, series-combination rated by circuit-breaker manufacturer to protect downstream feeder and branch circuit breakers.
7. Tenant Feeder Circuit Breakers: Series-combination-rated molded-case units, rated to protect circuit breakers in downstream tenant and to house load centers and panelboards that have 10,000-A interrupting capacity.
    a. Identification: Complying with requirements in Section 26 05 53 "Identification for Electrical Systems" with legend identifying tenant's address.
    b. Physical Protection: Tamper resistant, with hasp for padlock.
8. Meter Socket: Rating coordinated with indicated tenant feeder circuit rating.
9. Surge Protection: For main disconnect device, comply with requirements in Section 26 43 13 "Surge Protection for Low-Voltage Electrical Power Circuits."

F. Arc-Flash Warning Labels;
1. Labels: Comply with requirements for "Arc-Flash Warning Labels" in Section 26 05 73.19 "Arc-Flash Studies." Apply a 3-1/2-by-5-inch (76-by-127-mm) thermal transfer label of high-adhesion polyester for each work location included in the analysis.
2. Labels: Comply with requirements for "Self-Adhesive Equipment Labels" and "Signs" in Section 26 05 53 "Identification for Electrical Systems." Apply a 3-1/2-by-5-inch (76-by-127-mm) thermal transfer label of high-adhesion polyester for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
    a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
        1) Location designation.
        2) Nominal voltage.
        3) Flash protection boundary.
        4) Hazard risk category.
        5) Incident energy.
        6) Working distance.
3. Engineering report number, revision number, and issue date.

2.02 EQUIPMENT FOR ELECTRICITY METERING BY CONTRACTING AGENCY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
1. Square D; a brand of Schneider Electric
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution
4. Electrotech Industries
5. E-Mon; a division of Hunt Power.

B. General Requirements for Contracting Agency's Meters:
1. Comply with UL 1244.
2. Meters used for billing shall have an accuracy of 0.2 percent of reading, complying with requirements in ANSI C12.20.
3. Enclosure: NEMA 250, Type 1 minimum, with hasp for padlocking or sealing.
4. Meters installed outdoor shall be in NEMA 4X stainless steel enclosure. Meter in enclosure shall be factory installed and assembled with strip heaters controlled by thermostat.
5. Identification: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
6. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
7. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.
    a. Type: Split core.

8. Current-Transformer Cabinet: Listed or recommended by metering equipment manufacturer for use with sensors indicated.
9. Building Automation System (BAS) Interface: One digital KY pulse to a user-definable increment of energy measurement. Match signal to BAS input and arrange to convey the instantaneous, integrated, demand level measured by meter to provide data for processing and possible programmed demand control action by destination system.

C. Kilowatt-hour Meter: Electronic single- and three-phase meters, measuring electricity used.
1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
2. Display: LCD with characters not less than 0.25 inch (6 mm) high, indicating accumulative kilowatt-hours and current kilowatt load. Retain accumulated kilowatt-hour in a nonvolatile memory, until reset.
3. Display: Digital electromechanical counter, indicating accumulative kilowatt-hours.

D. Kilowatt-hour/Demand Meter: Electronic single- and three-phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.
1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
2. Display: LCD with characters not less than 0.25 inch (6 mm) high, indicating accumulative kilowatt-hours, current time and date, current demand, and historic peak demand, and time and date of historic peak demand. Retain accumulated kilowatt-hour and historic peak demand in a nonvolatile memory, until reset.

E. Data Transmission Cable: Transmit KY pulse data over Class 1 control-circuit conductors in raceway. Comply with Section 26 05 23 "Control-Voltage Electrical Power Cables."

F. Software: PC based, a product of meter manufacturer, suitable for calculation of utility cost allocation and billing.
1. Tenant or Activity Billing Software: Automatically import energy-usage records to automatically compute and prepare tenant bills based on metering of energy use and peak demand. Maintain separate directory for each tenant's historical billing information. Prepare summary reports in user-defined formats and time intervals.

G. Accessories:
1. Fuses: Provide fuses to protect meters.
2. Shunting Devices: Provide shunting devices for maintenance of meters.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

C. Install modular meter center according to NECA 400 switchboard installation requirements.

D. Install arc-flash labels as required by NFPA 70.

E. Connect all new meters to BMS and provide compatible wiring and conduit.

F. Wiring Method:
1. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
2. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Section 27 15 13 " Copper Horizontal Cabling."
3. Minimum conduit size shall be 1/2 inch (13 mm).

3.02 IDENTIFICATION

A. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.
2. Equipment Identification Labels: Adhesive film labels with clear protective overlay.

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
   2. Turn off circuits supplied by metered feeder and secure them in off condition.
   3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
   4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results. This shall be done in the presence of Contracting Agency's Meter Shop Personnel. Coordinate through Contracting Agency.

C. Electricity metering will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 26 27 13

This page intentionally left blank

SECTION 26 27 26
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Receptacles, receptacles with integral GFCI, and associated device plates.
B. USB receptacles.
C. SPD receptacles, 125 V, 20 A.
D. Hospital-grade receptacles, 125 V, 20 A.
E. Hazardous (classified) location receptacles.
F. Twist-locking receptacles.
G. Isolated-ground receptacles.
H. Tamper-resistant receptacles.
I. Weather-resistant receptacles.
J. Snap switches and wall-box dimmers.
K. Solid-state fan speed controls.
L. Wall-switch and exterior occupancy sensors.
M. Communications outlets.
N. Toggle switches, 120/277 V,20 A.
O. Decorator-style devices, 20 A.
P. Pendant cord-connector devices.
Q. Cord and plug sets.
R. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.02 DEFINITIONS

A. AFCI: Arc-fault circuit interrupter.
B. EMI: Electromagnetic interference.
C. GFCI: Ground-fault circuit interrupter.
D. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
E. RFI: Radio-frequency interference.
F. SPD: Surge Protective Device.
G. UTP: Unshielded twisted pair.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Receptacles for Contracting Agency-Furnished Equipment: Match plug configurations.
   2. Cord and Plug Sets: Match equipment requirements.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
C. Samples: One for each type of device and wall plate specified, in each color specified.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Service/Power Poles: One for every 10, but no fewer than one.
   2. Floor Service-Outlet Assemblies: One for every 10, but no fewer than one.
   3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.
   4. SPD Receptacles: One for every 10 of each type installed, but no fewer than two of each type.

1.08 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer. Switches, receptacles and cover plates shall be of the same manufacturer.

B. Comply with National Electrical Manufacturer's Association (NEMA) standards. Furnish products listed and classified by Underwriter's Laboratories Inc. as suitable for purpose specified and shown.

C. Manufacturer shall have a minimum of ten (10) years experience in the production of wiring devices specified and shall have ISO 9001 and 9002 certifications.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
   1. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
   2. Leviton Mfg. Company Inc. (Leviton).
   3. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: UL Listed and labeled, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
   1. Connectors shall comply with UL2459 and shall be made with stranding building wire.
   2. Devices shall comply with the requirements in this Section.

2.03 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125V, 20A: Comply with NEMA WD1, NEMAWD6 Configuration 5-20R, UL498, and FSW-C-596.
   1. Products: Subject to compliance with requirements, provide one of the following manufacturers :
      a. Hubbell; HBL5361 (single), HBL5362 (duplex).
      b. Leviton; 5361 (single), 5362 (duplex).
      c. Pass & Seymour; 5361 (single), 5362 (duplex).
   2. Description: Grounded, industrial extra heavy duty specifications grade, back- and side-wired, single-piece grounding brass strap with integral ground, impact-resistant thermoplastic nylon cover and body, smooth face, with separate grounding screw and NEMA 5-20R plug configurations.

3. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, single piece brass mounting strap with integral ground, impact resistant thermoplastic nylon cover and body, smooth face and separate grounding screw.
4. Products: Subject to compliance with requirements, provide one of the following manufacturers
   a. Hubbell; HBL8300SGA.
   b. Leviton; 8300-SGG.
   c. Pass & Seymour; TR63H.
5. Description: Grounded, specifications grade, back- and side-wired, single-piece grounding brass strap with integral ground, impact-resistant thermoplastic nylon cover and body, smooth face, 20A, 125V, duplex, with separate grounding screw and NEMA 5-20R plug configurations.
6. Labeled shall comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

B. Isolated-Ground, Duplex Convenience Receptacles, 125V, 20A: Comply with NEMA WD 1, NEMA WD 6 Configuration5-20R, UL498, and FSW-C-596.
1. Products: Subject to compliance with requirements, provide the following manufacturers
   a. Hubbell; IG5362.
   b. Leviton; 5362-IG.
   c. Pass & Seymour; IG5362.
2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

C. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

D. Weather-Resistant Duplex Receptacle, 125 V, 20 A
1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.

E. Controlled Duplex Receptacles, 125 V, 20A
1. Description: Two pole, three wire and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.
4. Marking: Shall have permanent marking per NEC 130.5 (d).
5. USB Receptacles: Dual and quad, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
6. Standards: Comply with UL 1310 and USB 3.0 devices.

F. USB Charging Receptacles :
1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
2. USB Receptacles: Dual and quad, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
3. Standards: Comply with UL 1310 and USB 3.0 devices.

G. Tamper-Resistant Duplex and USB Charging Receptacles :
1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.
2. Line Voltage Receptacles: Two pole, three wire, and self-grounding; NEMA WD 6, Configuration 5-20R.
3. USB Receptacles: Dual USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).

4. Standards: Comply with UL 498, UL 1310, USB 3.0 devices, and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.04 GFCI RECEPTACLES

A. General Description:
1. Straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
4. Include self test feature so that the outlet is automatically tested every fifteen minutes.
5. Outlets used in coastal environments shall be suitable for such applications and shall be properly protected against the ambient conditions.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
a. Hubbell; GFR5352L.
b. Pass & Seymour; 2095.
c. Leviton; 7590.

C. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
a. Hubbell; GFTR20.
b. Pass & Seymour; 2095TR.

2.05 SPD RECEPTACLES

A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 1449, and FS W-C-596, with integral SPD in line to ground, line to neutral, and neutral to ground.
1. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
2. Active SPD Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

B. Duplex SPD Convenience Receptacles:
1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
a. Hubbell; HBL5362SA.
b. Leviton; 5380.
c. Pass & Seymour; 5362BLSP.
2. Description: Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.

C. Isolated-Ground, Duplex SPD Convenience Receptacles:
1. 1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
a. Cooper; IG5362BLS.
b. Hubbell; IG5362SA.
c. Leviton; 5380-IG.
d. Pass & Seymour; IG5362BLSP.
2. Description:
a. Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

D. Isolated-Ground, Hospital-Grade, Duplex SPD Convenience Receptacles:
   1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
      a. Hubbell; IG8362SA.
      b. Leviton; 8380-IG.
      c. Pass & Seymour; IG8300BLSP.
   2. Description:
      a. Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
      b. Comply with UL 498 Supplement sd.
      c. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.06 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
      a. Cooper Crouse-Hinds.
      b. EGS/Appleton Electric.
      c. Killark; Division of Hubbell Inc.

2.07 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following manufacturers
      a. Hubbell; HBL2310.
      b. Leviton; 2310.
      c. Pass & Seymour; L520-R.

B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
      a. Cooper; IGL520R.
      b. Hubbell; IG2310.
      c. Leviton; 2310-IG.
      d. Pass & Seymour; IG4700.
   2. Description:
      a. Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
      b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.08 PENDANT CORD-CONNECTOR DEVICES

A. Description:
   1. Matching, locking-type plug and receptacle body connector.
   2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
   3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
   4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.09 CORD AND PLUG SETS

A. Description:
   1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
   2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
   3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.10 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
      1) Single Pole:
         a) Hubbell; HBL1221.
         b) Leviton; 1221-2.
         c) Pass & Seymour; CSB20AC1.
      2) Two Pole:
         a) Hubbell; HBL1222.
         b) Leviton; 1222-2.
         c) Pass & Seymour; CSB20AC2.
      3) Three Way:
         Hubbell; HBL1223.
         a) Leviton; 1223-2.
         b) Pass & Seymour; CSB20AC3.
      4) Four Way:
         a) Hubbell; HBL1224.
         b) Leviton; 1224-2.
         c) Pass & Seymour; CSB20AC4.

C. Pilot-Light Switches, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
      a. Hubbell; HBL1201PL for 120 and 277 V.
      b. Leviton; 1221-LH1.
      c. Pass & Seymour; PS20AC1RPL for 120 V, PS20AC1RPL7 for 277 V.
   2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Key-Operated Switches, 120/277 V, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Hubbell; HBL1221L.
      b. Leviton; 1221-2L.
      c. Pass & Seymour; PS20AC1-L.
   2. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.
   1. Products: Subject to compliance with requirements, provide one of the following
      a. Hubbell; HBL2057.
      b. Leviton; 1257.
      c. Pass & Seymour; 1251.

F. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Hubbell; HBL2057L.
      b. Leviton; 1257L.
      c. Pass & Seymour; 1251L.

G. Antimicrobial, Double-Pole Switches, 120/277 V, 20 A :
   1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
      a. Standards: Comply with UL 20 and FS W-S-896.

H. Antimicrobial, Three-Way Switches, 120/277 V, 20 A :
   1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
      a. Standards: Comply with UL 20 and FS W-S-896.

2.11 DECORATOR-STYLE DEVICES

A. Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
      a. Hubbell; DR20.
      b. Leviton; 16252.
      c. Pass & Seymour; 26252.

B. Tamper-Resistant Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
      a. Hubbell; DR20TR.
      b. Pass & Seymour; TR26252.
   2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

C. Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
      a. Hubbell; DR20TR.
      b. LevitonTRW20.
      c. Pass & Seymour; TRW26252.
   2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section, when installed in wet and damp locations.

D. GFCI, Feed-Through Type, Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and UL 943 Class A.
   1. Products: Subject to compliance with requirements, provide one of the following manufacturers
      a. Hubbell; GF20LA.
      b. Leviton; 8599.
      c. Pass & Seymour; 2094.

E. GFCI, Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and UL 943 Class A.
   1. Products: Subject to compliance with requirements, provide one of the following manufacturers
      a. Hubbell; GFTR20.
      b. Pass & Seymour; 2094TRWR.
   2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

F. Toggle Switches, Square Face, 120/277 V, 20 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.
   1. Products: Subject to compliance with requirements provide one of the following manufacturers
      a. Hubbell; DS120 (single pole), DS320 (three way).
      b. Leviton; 5621-2 (single pole), 5623-2 (three way).
      c. Pass & Seymour; 2621 (single pole), 2623 (three way).

G. Lighted Toggle Switches, Square Face, 120 V, 20 A: Comply with NEMA WD 1 and UL 20.
   1. Products: Subject to compliance with requirements, provide one of the following manufacturers :
      a. Cooper; 7631 (single pole), 7633 (three way).
      b. Hubbell; DS120IL (single pole), DS320 (three way).
      c. Leviton; 5631-2 (single pole), 5633-2 (three way).
      d. Pass & Seymour; 2625 (single pole), 2626 (three way).
   2. Description: With neon-lighted handle, illuminated when switch is "off."

2.12 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: Smooth, high-impact thermoplastic or 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel
   3. Material for Unfinished Spaces: Galvanized steel.
   4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant with lockable cover.

C. Antimicrobial Cover Plates:
   1. Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
   2. Tarnish resistant.

2.13 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

2.14 PREFABRICATED MULTIOUTLET ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Hubbell Incorporated; Wiring Device-Kellems.
   2. Wiremold/Legrand.

B. Description:

1. Two-piece surface metal raceway, with factory-wired multioutlet harness.
2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Metal, with manufacturer's standard finish.

D. Multioutlet Harness:
1. Receptacles: 15-A, 125-V, NEMA WD 6 Configuration 5-15R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
2. Receptacle Spacing: 6 inches (150 mm).
3. Wiring: No. 12 AWG solid, Type THHN copper, two circuit, connecting alternating receptacles.

2.15 SERVICE POLES

A. Description:
1. Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
2. Poles: Nominal 2.5-inch- (65-mm-) square cross section, with height adequate to extend from floor to at least 6 inches (150 mm) above ceiling, and with separate channels for power wiring and voice and data communication cabling.
3. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
4. Finishes: Manufacturer's standard painted finish and trim combination.
5. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, four-pair, Category 3 or Category 5 voice and data communication cables.
6. Power Receptacles: Two duplex, 20-A, straight-blade receptacles complying with requirements in this Section.

2.16 FINISHES

A. Device Color:
1. Wiring Devices Connected to Normal Power System: White or as selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. SPD Devices: Blue.
4. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:
1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:
1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.
2. Install hospital-grade receptacles in patient-care areas with the ground pin at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.03 IDENTIFICATION

A. Comply with Section 26 05 53 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with white-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.

3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:
   1. Line Voltage: Acceptable range is 110 to 125 V.
   2. Percent Voltage Drop under 20-A Load: A value of 6 percent or higher is unacceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.
   6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight-blade convenience outlets in patient-care areas and hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

D. Wiring device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports. Submit reports within two (2) weeks of completion of tests.

END OF SECTION 26 27 26

This page intentionally left blank

SECTION 26 28 13
FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches panelboards, switchboards, enclosed controllers, and, motor-control centers.

B. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches, fuseholders, and panelboards.

C. Retain first subparagraph below if retaining rejection-base-type plug fuses and if Project contains fuseholders with Edison-base, plug-fuse sockets.

D. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.

E. Spare-fuse cabinets.

1.02 RELATED DOCUMENTS

A. Section 26 00 00 “General Electrical Requirements.”

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
    a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 1-11 "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit on translucent log-log graph paper.
4. Coordination charts and tables and related data.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than 3 of each size and type.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.07 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C)or more than 100 deg F (38 deg C) , apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.08 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Cooper Bussmann, Inc.
   2. Edison Fuse, Inc.
   3. Ferraz Shawmut, Inc.
   4. Littelfuse, Inc.

2.02 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.03 PLUG FUSES

A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.04 PLUG-FUSE ADAPTERS

A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

2.05 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
   1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
   2. Finish: Gray, baked enamel.
   3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
   4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS

A. Cartridge Fuses:
   1. Service Entrance: Class L, time delay
   2. Feeders: Class L, time delay
   3. Motor Branch Circuits: Class RK5, time delay.
   4. Other Branch Circuits: Class J, fast acting
   5. Control Circuits: Class CC, fast acting.

B. Plug Fuses:
   1. Motor Branch Circuits: Type S, dual-element time delay.
   2. Other Branch Circuits: Type S, dual-element time delay.

3.03 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.

C. Install spare-fuse cabinet(s).

3.04 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

This page intentionally left blank

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fusible switches.

B. Nonfusible switches.

C. Receptacle switches.

D. Shunt trip switches.

E. Molded-case circuit breakers (MCCBs).

F. Molded-case switches.

G. Enclosures.

1.02 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.03 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.04 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current ratings (interrupting and withstand, as appropriate).
   4. Include evidence of NRTL listing for series rating of installed devices.
   5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
   6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Manufacturer's field service report.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 1-11 "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than 3 of each size and type.
   2. Fuse Pullers: 2 for each size and type.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.09 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
   2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Contracting Agency or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Construction Manager no fewer than 7 days in advance of proposed interruption of electric service.
   2. Indicate method of providing temporary electric service.
   3. Do not proceed with interruption of electric service without Construction Manager's written permission.
   4. Comply with NFPA 70E.

1.10 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 PRODUCTS

2.01 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.

B. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate indicated fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 600V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw,600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Double Throw,600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
   6. Hookstick Handle: Allows use of a hookstick to operate the handle.
   7. Lugs: Compression type, suitable for number, size, and conductor material.
   8. Service-Rated Switches: Labeled for use as service equipment.
   9. Accessory Control Power Voltage: Remote mounted and powered; 24-V ac

2.02 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.

B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
   5. Hookstick Handle: Allows use of a hookstick to operate the handle.
   6. Lugs: Compression type, suitable for number, size, and conductor material.
   7. Accessory Control Power Voltage: Remote mounted and powered; 24-V ac

2.03 RECEPTACLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy-Duty, Single-Throw Fusible Switch: 600-V ac, 100 A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

C. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: 240 600-V ac, 30 60 100 A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

2.04 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper Bussmann, Inc.
   2. Ferraz Shawmut, Inc.
   3. Littelfuse, Inc.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:
   1. Oiltight key switch for key-to-test function.
   2. Oiltight Red ON pilot light.
   3. Isolated neutral lug; 100 percent rating.
   4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
   5. Form C alarm contacts that change state when switch is tripped.
   6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
   7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.05 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
   1. Instantaneous trip.
   2. Long- and short-time pickup levels.
   3. Long- and short-time time adjustments.
   4. Ground-fault pickup level, time delay, and I^2t response.

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

J. Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
   4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

5. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system, specified in Section 26 09 13 "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
8. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
11. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
12. Electrical Operator: Provide remote control for on, off, and reset operations.
13. Accessory Control Power Voltage: integrally mounted, self-powered 120-V ac

2.06 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   2. Siemens Energy & Automation, Inc.
   3. Square D; a brand of Schneider Electric.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:
   1. Standard frame sizes and number of poles.
   2. Lugs: Mechanical Compression type, suitable for number, size, trip ratings, and conductor material.
   3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
   4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
   5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
   6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
   7. Alarm Switch: One NO NC contact that operates only when switch has tripped.
   8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
   9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
   10. Electrical Operator: Provide remote control for on, off, and reset operations.
   11. Accessory Control Power Voltage: Integrally mounted, self-powered 120-V ac

2.07 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1
   2. Outdoor Locations: NEMA 250, Type 3R
   3. Wash-Down Areas: NEMA 250, Type 4X
   4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4X
   5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 9

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

3.03 IDENTIFICATION

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:
   1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

E. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Perform the following infrared scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
      b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
      c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

END OF SECTION 26 28 16

SECTION 26 31 00
PHOTOVOLTAIC COLLECTORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. PV system description.

B. Manufactured PV units.

C. PV module framing.

D. PV array construction.

E. Inverters.

F. System overcurrent protection.

G. Mounting structures.

1.02 RELATED DOCUMENTS

A. Section 26 00 00 “General Electrical Requirements.”

1.03 DEFINITIONS

A. ETFE: Ethylene tetrafluoroethylene.

B. FEP: Fluorinated ethylene propylene.

C. IP Code: Required ingress protection to comply with IEC 60529.

D. MPPT: Maximum power point tracking.

E. PTC: PVUSA Test Condition. Commonly regarded as a "real-world" measure of PV output. See below for definition of "PVUSA."

F. PV: Photovoltaic.

G. PVUSA: Photovoltaics for Utility Systems Applications.

H. STC: Standard Test Conditions defined in IEC 61215.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for PV panels.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For PV modules.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Detail fabrication and assembly.
   4. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For solar photovoltaic on rooftop, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special materials and workmanship warranty and minimum power output warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For PV modules to include in operation and maintenance manuals.

1.07 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of PV modules that fail in materials or workmanship within specified warranty period.
   1. Manufacturer's materials and workmanship warranties include, but are not limited to, the following:
      a. Faulty operation of PV modules.
   2. Warranty Period: 5 years from date of Substantial Completion.

B. Manufacturer's Special Minimum Power Output Warranty: Manufacturer agrees to repair or replace components of PV modules that fail to exhibit the minimum power output within specified warranty period. Special warranty, applying to modules only, applies to materials only, on a prorated basis, for period specified.
   1. Manufacturer's minimum power output warranties include, but are not limited to, the following warranty periods, from date of Substantial Completion:
      a. Specified minimum power output to 90 percent or more, for a period of 15 years.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers
   1. LG.
   2. Lumos.
   3. Mission Solar.
   4. SolarTech Universal.
   5. Tesla.

2.02 SCOPE

A. Rooftop Solar photovoltaic (PV) is a delegated design. Contractor to provide full design, construction and shop drawings of the PV system with string inverters or central inverter for a maximum of 99.5 KW rating. Contractor shall determine the cost effective option between two system and system shall be tied to the main services as shown on the single line diagrams from bid set.

B. Contractor shall coordinate with utility for their requirements related to rapid shut down or any additional requirements.

2.03 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Hazardous Locations: FM Global approved for NFPA 70, Class 1, Division 2, Group C and Group D.

C. Seismic Qualification Certificates: For Inverter, combiner box, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

2.04 PV CAPACITIES AND CHARACTERISTICS

A. Minimum Electrical Characteristics:

1. Rated Open-Circuit Voltage: 41Vdc
2. Maximum System Voltage: 1000Vdc
3. Maximum Power at Voltage (Vpm): 500w.
4. Short-Circuit Temperature Coefficient: 10.6/deg C.
5. Rated Short-Circuit Current (Isc): 20A max.
6. Maximum System: 1000 V dc.
7. Rated Operation Current (Imp): 7.5A.
8. Maximum Power at STC (Pmax): 300w

2.05 PV SYSTEMS DESCRIPTION

A. Stand-Alone PV System: Collectors connected to provide power to Project dc and ac loads through an energy storage system.
   1. A 3 to 6 module array to generate a total nominal rated output of 99.5KW.
   2. System Components:
      a. PV modules.
      b. Array frame.
      c. Charge controller.
      d. Energy storage.
      e. Inverter.
      f. Overcurrent protection, disconnect, and rapid shutdown devices.
      g. Mounting structure.

2.06 MANUFACTURED PV UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers
   1. LG
   2. Lumos
   3. Mission Solar
   4. SolarTech Universal
   5. Tesla

B. Cell Materials: Monocrystalline.
   1. c-Si.
   2. Gallium arsenide (GaAs).

C. Bypass Diode Protection: external.

D. Junction Box:
   1. Size: 1.56 by 3.96 by 0.52 inch (39.6 by 100.6 by 13.2 mm).
   2. Fully potted, vandal resistant.
   3. IP Code: IP67.
   4. Flammability Test: UL 1703.

E. Output Cabling:
   1. 0.158 inch (4 mm).
   2. MC4 connectors.
   3. Two-Conductor Harness: No traditional return wire is needed from the end of a row back to the source combiner.

F. Series Fuse Rating: 30A or less.

2.07 PV MODULE FRAMING

A. PV laminates mounted in anodized extruded-aluminum frames.
   1. Entire assembly UL listed for electrical and fire safety, Class A, according to UL 1703, and complying with IEC 61215.
   2. Frame strength exceeding requirements of certifying agencies in subparagraph above.
   3. Finish: Anodized aluminum.

a. Alloy and temper recommended by framing manufacturer for strength, corrosion resistance, and application of required finish.
b. Color: As indicated by manufacturer's designations.

4. Finish: High-performance organic finish.
   a. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent PVC resin by weight.
   b. Color: As indicated by manufacturer's designations.
5. Finish: Baked-enamel finish.
   a. Color: As indicated by manufacturer's designations.

2.08 PV ARRAY CONSTRUCTION

A. Framing:
   1. Material: Extruded aluminum.
   2. Maximum System Weight: Less than 4 lb/sq. ft. (19.53 kg/sq. m).
   3. Raceway Cover Plates: Aluminum.

B. Flat-Roof Mounting:
   1. No roof penetrations.
   2. Self-ballasting.
   3. Wind-tunnel tested to 110-mph (160-km/h) wind.
   4. Service Life: 15 years.
   5. Freestanding system.

2.09 INVERTER

A. Inverter Type: Central.

2.10 MANUFACTURED INVERTER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers
   1. SMA America
   2. SolarEdge
   3. Yaskawa Solectria
   4. Outback

B. Inverter Electrical Characteristics:
   1. Maximum Recommended PV Input Power: 50KW.
   2. Maximum Open-Circuit Voltage: 800V.
   3. MPPT Voltage Range: 150 – 1000V
   4. Maximum Input Current: 120A.
   5. Number of String Inputs: 120A.
   6. Number of Independent MPPT Circuits: 6.
   7. Nominal Output Voltage: 480/277V.
   8. Maximum Output Current: 40A.
   9. Peak Efficiency: 97.5 percent min.
   10. DC/AC Terminal Range (AWG): 4 to 4/0.
   11. Communications Interface: RS 485 Ethernet.

C. Operating Conditions:
   1. Operating Ambient Temperatures: Minus 4 to plus 122 deg F (20 to plus 50 deg C).
   2. Storage Temperature: Minus 40 to plus 122 deg F (minus 40 to plus 50 deg C).
   3. Relative Humidity: Zero to 95 percent, noncondensing.

D. Charge controllers shall have the following:
   1. Overcurrent protection.
   2. Generator input breaker box.
   3. Automatic transfer relay.

4. Digital display.
5. Transformer.
6. Disconnect switch.
7. Shunt controller.
8. Shunt regulator.
9. Surge overload protection.

E. Enclosure:
1. NEMA 250 Type 4X.
2. Enclosure Material: Galvanized steel.
3. Cooling Methods:
a. Fan convection cooling.
b. Passive cooling.
4. Protective Functions:
a. AC over/undervoltage.
b. AC over/underfrequency.
c. Ground overcurrent.
d. Overtemperature.
e. AC and dc overcurrent.
f. DC overvoltage.
5. Standard LCD, four lines, 20 characters, with user display and on/off toggle switch.

F. Disconnects: Rated for system voltage and conductor.

G. Regulatory Approvals:
1. IEEE 1547.1.
2. IEEE 1547.3.
3. UL 1741.

2.11 SYSTEM OVERCURRENT PROTECTION

A. Circuit Breakers: 150A.

2.12 MOUNTING STRUCTURES

A. Roof Mount: Extruded aluminum, two rails, tilt legs, and roof standoffs.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrate areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Do not begin installation until mounting surfaces have been properly prepared.

C. If preparation of mounting surfaces is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Examine modules and array frame before installation. Reject modules and arrays that are wet, moisture damaged, or mold damaged.

E. Examine roofs, supports, and supporting structures for suitable conditions where PV system will be installed.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with NECA 1.

B. Coordinate layout and installation of PV panels with roof assembly and other construction.

C. Support PV panel assemblies independent of supports for other elements such as roof and support assemblies, enclosures, vents, pipes, and conduits. Support assembly to prevent twisting from eccentric loading.

D. Install PV inverters, rapid shutdown, and system control in locations indicated on Drawings.

E. Install weatherseal fittings and flanges where PV panel assemblies penetrate exterior elements such as walls or roofs. Seal around openings to make weathertight. See Section 07 92 00 "Joint Sealants" for materials and application.

F. Seismic Restraints: Comply with requirements for seismic-restraint devices specified in Section 26 05 48.16 "Seismic Controls for Electric Systems."

G. Wiring Method: Install cables in raceways.

H. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.03 CONNECTIONS

A. Coordinate PV panel cabling to equipment enclosures to ensure proper connections.

B. Coordinate installation of utility-interactive meter with utility.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

D. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

END OF SECTION 26 31 00

SECTION 26 32 13
ENGINE GENERATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged engine-generator sets for standby power supply with the following features:
   1. Diesel engine.
   2. Generators
   3. Unit-mounted cooling system.
   4. Unit-mounted control and monitoring.
   5. Performance requirements for sensitive loads.
   6. Load banks.
   7. Outdoor enclosure.
   8. Battery charger.
   9. Muffler.
   10. Exhaust piping external to set.
   11. Remote annunciator.
   12. Remote radiator.
   13. Remote stop switch.
   14. Starting battery and charger.

1.02 RELATED REQUIREMENTS

A. Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Section 26 24 16 “Panelboards”

C. Section 26 28 16 Enclosed Switches and Circuit Breakers.

D. Section 26 36 00 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.03 RELATED DOCUMENTS

A. Section 26 00 00 “General Electrical Requirements.”

1.04 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

B. LP: Liquid petroleum.

C. NETA: InterNational Electrical Testing Association

D. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in Hertz or cycles per second.

E. OSHPD: Office of Statewide Health Planning and Development

1.05 STANDARDS

A. National Electrical Manufacturer's Association (NEMA).

B. National Fire Protection Association (NFPA).

1.06 ACTION SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
   1. Thermal damage curve for generator.
   2. Time-current characteristic curves for generator protective device.
   3. Technical data sheets of each equipment.

B. Shop Drawings: Design of the concrete base or structural design of the generator shall be delegated to the contractor and approved by the approved structural engineer of record.

C. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
   2. Brake horsepower of engine.
   3. Fuel consumption and floor plans showing fuel line connections, pipe sizes and pump requirements.
   4. Cooling air requirements and its design.
   5. Noise db level.
   6. Electrical characteristics of generator, voltage regulator, and battery charger.
   7. Load graphs and load calculations to show the capabilities to supply the largest motor while connected to the full load. It shall also indicate the sequencing of the emergency load start-up.
   8. Control panel.
   9. Elevations of equipment including front elevation, side elevation, top view for complete assembly.
   10. Engine and generator details, including governor, turbocharger, exciter, after/intercooler, main fuel storage tank and associated required pumping drawings. The work shall indicate the method of the installation of the electrical, mechanical and plumbing work.
   11. Certified independent test lab data of generator characteristics, verification of emissions conformance to latest applicable regulations of CARB and AQMD.
   12. Main line circuit breaker.
   13. List showing manufacturer of each major component.
   14. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   15. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
   16. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer installed and field installed wiring.
   17. Indicate name and place of manufacture of each major component.

1.07 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Manufacturer's dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Coordination Drawings: Pad sizing and seismic calculations shall be delegated to the contractor and approved by the approved structural engineer of record. Floor plans, drawn to scale (1/4"=1'-0"), showing dimensioned layout, required working clearances, and required area above and around Engine Generator set where pipe and ducts are prohibited. Show Engine Generator layout and relationships between electrical components and adjacent structural and

mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

C. Manufacturer's certified letter stating that unit complies with all California State Codes, Uniform Building Code (UBC), California Air Resource Board (CARB), California Electrical Code (CEC), latest edition and supplements and National Electric Manufacturer's Association (NEMA) standards for an emergency power plant.

D. Sound levels shall be measured in the octave bands, having center frequencies from 31.5 Hz to 8000 Hz according to the procedures given in American National Standards Institute (ANSI) Standards Sl.13.71. Measurements shall be made in at least four locations as described in the standard and shall be made at a distance of one meter from the surface of the equipment. Sound levels generated shall be within acceptable limits.

E. Qualification Data: For installer, manufacturer and testing agency.

F. Source quality-control test reports.
   1. Certified summary of prototype-unit test report.
   2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
   3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
   4. Certified Test Report of factory tests on units to be shipped for this Project, showing evidence of compliance with specified requirements. Submit within two (2) weeks of completion of tests. Report shall be signed by a factory testing engineer.
   5. Report of sound generation.
   6. Report of exhaust emissions showing compliance with applicable regulations.
   7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

G. Field quality-control test reports.

H. Warranty: Special warranty specified in this Section.

1.08 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 1-11 "Operation and Maintenance Data," include the following:
   1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply (address and phone number of sources).

1.09 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
   2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
   3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

1.10 QUALITY ASSURANCE

A. If alternate manufacturer of products other than what are specified in this section are submitted, all necessary documents not limited to cut sheets, technical information, test reports from recognized testing labs and factory test reports shall be submitted to the satisfaction of the Contracting Agency/engineer to ensure quality and conformance to the specifications. Additional testing shall be undertaken if it is concluded by the Contracting Agency/engineer that the submitted test reports are either insufficient or do not include all tests necessary for product acceptance. The tests shall be conducted by a recognized lab acceptable to the Contracting Agency/engineer and all tests shall be witnessed by Contracting Agency's/engineer's personnel. All testing procedures and test results shall be satisfactory to the Contracting Agency/engineer. Contractor shall be responsible for arranging the tests, for transportation, food and lodging for minimum of one Contracting Agency's/engineer's representative to witness the test at the testing lab. Include all costs for the above in the bid.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 75 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Contractor shall ensure that the manufacturer has a minimum of 15 years experience in the production of Emergency/Standby Engine Generators similar to the type and size specified in this project. Furnish a list of three (3) contacts for the three (3) similar projects completed within the last 5 years. Include name, tele no and email of the facility engineers.

D. Manufacturer shall have ISO 9001 or 9002 Certification.

E. Manufacturer shall have ability to readily provide replacement parts for a minimum period of ten (10) years, from the date of completion of the project. Furnish a letter from the manufacturer confirming the availability.

F. Engine Generators shall be assembled at the manufacturer's own manufacturing facility using its own major devices (e.g., circuit breakers) for the assembly. These devices shall be normally carried by the manufacturer as standard catalog items.

G. Engine Generators shall comply with seismic zone applicable to the project. Unless otherwise indicated, verify requirements with Architect or Structural Engineer of Record (SEOR). Provide certified test reports of shake table test done by manufacturer on similar units.

H. Materials and equipment shall be new, modern in design and shall not have been in prior service except as required by factory tests. Major components (e.g. engines, generators, governers, controls) shall be manufactured within six months of installation.

I. Source Limitations: Obtain packaged engine generators, and accessories through one source from a single manufacturer through a local distributor. Manufacturer of overcurrent devices shall match other power distribution equipment on the project.

J. Comply with ASME B15.1.

K. Comply with NFPA 37.

L. Comply with NFPA 70.

M. Comply with NFPA 99.

N. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

O. Comply with UL 2200.

P. Engine Exhaust Emissions: Comply with applicable state and local government requirements. Engine Exhaust Emissions: Apply and obtain a permit to construct and a permit to operate from Air Pollution Control District (authority having jurisdiction of the project) including payment of permit fees and health risk assessment fees. Contractor shall submit complete emission data along with the shop drawings for the generator set within six (6) weeks of receiving Notice to Proceed. Contractor shall not start installation without proper permits from the authority having jurisdiction.

Q. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

R. Product Options: Drawings indicate size, profiles, and dimensional requirements of engine generators and are based on the specific system indicated. Refer to Part 2 "Product Requirements."

S. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70, Article 100–and marked for intended location and application.

T. Testing Agency Qualifications: Member of NETA;
   1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of ten (10) years and has permanent in-house testing engineers and technicians involved with testing of switchboards, panelboards and OCPDs similar to those specified on this project.
   2. Testing company shall be located with 50 miles radius of the project.

3. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing to supervise on-site testing specified in Part 3.

U. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
   1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
   2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

1.11 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
   1. Ambient Temperature: 5 to 40 deg C.
   2. Relative Humidity: 0 to 95 percent.
   3. Altitude: Sea level to 1000 feet.

B. Unusual Service Conditions: Engine-generator equipment and installation are required to operate under the following conditions:
   1. High salt-dust content in the air due to salt storage.

1.12 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Coordinate size and location of roof curbs, equipment supports, and roof penetrations for remote radiators.

1.13 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 years from date of Substantial Completion.

1.14 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 24 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Caterpillar; Engine Div.
   2. Onan/Cummins Power Generation; Industrial Business Group
   3. Kohler Co.; Generator Division.
   4. MTU Onsite Energy Generator.
   5. Generac

2.02 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
   1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:
   1. Power Output Ratings: Nominal ratings as indicated
   2. Output Connections: Three-phase, four wire. Refer to drawings for more information.
   3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:
   1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
   2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
   3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
   4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
   5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
   6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
   7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
   8. Start Time: Comply with NFPA 110, Type 10, system requirements.

E. Generator-Set Performance for Sensitive Loads:
   1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
      a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
   2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
   3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
   4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
   5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
   6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
   7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
    a. Provide permanent magnet excitation for power source to voltage regulator.
10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.03 ENGINE

A. Fuel: ASTM D975-17

B. Rated Engine Speed: 3600 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.

D. Lubrication System: The following items are mounted on engine or skid:
1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:
1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
3. Dual Natural Gas with LP-Gas Backup (Vapor-Withdrawal) System:
    a. Carburetor.
    b. Secondary Gas Regulators: One for each fuel type.
    c. Fuel-Shutoff Solenoid Valves: One for each fuel source.
    d. Flexible Fuel Connectors: One for each fuel source.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

G. Governor: Mechanical.

H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
    a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

I. Cooling System: Closed loop, liquid cooled, with remote radiator and integral engine-driven coolant pump.
1. Configuration: Vertical air discharge.

2. Radiator Core Tubes: Aluminum
5. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
6. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
7. Fan: Driven by totally enclosed electric motor with sealed bearings.
8. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
9. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

J. Muffler/Silencer: Critical type, super quiet, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. Provide stainless steel type muffler including pipe connection to engine where these are exposed to weather.
1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 23 feet from exhaust discharge after installation is complete shall be 75 dBA or less.

K. Muffler/Silencer: Industrial type, super quiet, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine back-pressure requirements. Provide stainless steel type muffler including pipe connection to engine where these are exposed to weather.
1. Minimum sound attenuation of 12 dB at 500 Hz.
2. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 87 dBA or less.

L. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator. Provide new filters after completion for field tests and before acceptance by the Contracting Agency.

M. Starting System: 24-V electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.04 FUEL OIL STORAGE

A. Comply with NFPA 30. Fuel system shall be complete and shall consist of a dual filtering system, fuel storage tank, day tank and engine fuel pump. Provide fuel for testing and full tank after testing.

B. Day Tank: Comply with UL 142, freestanding, factory-fabricated fuel tank assembly, with integral, float-controlled transfer pump and the following features:
1. Containment: Integral rupture basin with a capacity of 150 percent of nominal capacity of day tank.
a. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of day-tank leak. Alarm shall be remotely monitored by BMS system.
2. Tank Capacity: 48 hours' operation at 100 percent of rated power output of engine-generator system without being refilled.
3. Pump Capacity: Exceeds maximum flow of fuel drawn by engine-mounted fuel supply pump at 110 percent of rated capacity, including fuel returned from engine.
4. Low-Level Alarm Sensor: Liquid-level device operates alarm contacts at 25 percent of normal fuel level.
5. High-Level Alarm Sensor: Liquid-level device operates alarm and redundant fuel shutoff contacts at midpoint between overflow level and 100 percent of normal fuel level.
6. Piping Connections: Factory-installed fuel supply and return lines from tank to engine; local fuel fill, vent line, overflow line; and tank drain line with shutoff valve.
7. Redundant High-Level Fuel Shutoff: Actuated by high-level alarm sensor in day tank to operate a separate motor device that disconnects day-tank pump motor. Sensor shall signal solenoid valve, located in fuel suction line between fuel storage tank and day tank, to close. Both actions shall remain in shutoff state until manually reset. Shutoff action shall initiate an alarm signal to control panel but shall not shut down engine-generator set.

C. Base-Mounted, Double-Wall Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
1. Tank level indicator.
2. Capacity: Fuel for 4 hours' continuous operation at 100 percent rated power output.
3. Leak detection in interstitial space.
4. Vandal-resistant fill cap.
5. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.05 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

C. Configuration:
   1. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
   2. Operating and safety indications, protective devices, basic system controls, and engine gages shall be groups in a common wall mounted control and monitoring panel.
   3. Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel features shall include the following:
      a. Switchboard Construction: Freestanding unit complying with Section 26 24 13 "Switchboards."
      b. Current and Potential Transformers: Instrument accuracy class

D. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel features shall include the following:
   1. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6. Power bus shall be copper. Bus, bus supports, control wiring, and temperature rise shall comply with UL 891.
   2. Switchboard Construction: Freestanding unit complying with Section 26 24 13 "Switchboards."
   3. Current and Potential Transformers: Instrument accuracy class.

E. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
   1. AC voltmeter.
   2. AC ammeter.
   3. AC frequency meter.
   4. DC voltmeter (alternator battery charging).
   5. Engine-coolant temperature gage.
   6. Engine lubricating-oil pressure gage.
   7. Running-time meter.
   8. Ammeter-voltmeter, phase-selector switch(es).
   9. Generator-voltage adjusting rheostat.
   10. Fuel tank derangement alarm.
   11. Fuel tank high-level shutdown of fuel supply alarm.
   12. Generator overload.

F. Indicating and Protective Devices and Controls:
   1. AC voltmeter.
   2. AC ammeter.
   3. AC frequency meter.
   4. DC voltmeter (alternator battery charging).
   5. Engine-coolant temperature gage.
   6. Engine lubricating-oil pressure gage.
   7. Running-time meter.
   8. Ammeter-voltmeter, phase-selector switch(es).
   9. Generator-voltage adjusting rheostat.

10. Start-stop switch.
11. Overspeed shutdown device.
12. Coolant high-temperature shutdown device.
13. Coolant low-level shutdown device.
14. Oil low-pressure shutdown device.
15. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel supply alarm.
17. Generator overload.

G. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

H. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Section 26 09 13 "Electrical Power Monitoring and Control."

I. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
1. Overcrank shutdown.
2. Coolant low-temperature alarm.
3. Control switch not in auto position.
4. Battery-charger malfunction alarm.
5. Battery low-voltage alarm.

J. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.
1. Engine high-temperature shutdown.
2. Lube-oil, low-pressure shutdown.
3. Overspeed shutdown.
4. Remote emergency-stop shutdown.
5. Engine high-temperature pre-alarm.
6. Lube-oil, low-pressure pre-alarm.
7. Fuel tank, low-fuel level.
8. Low coolant level.

K. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

L. Remote Emergency-Stop Switch: Red mush-room head type with an engraved label “EMERGENCY STOP SWITCH”. Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation with a transparent see-thru lexan cover.

2.06 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker (400A Frame and above): Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
1. Tripping Characteristics: Field adjustable long-time and short-time delay and instantaneous. Trip unit shall be field replaceable.
2. Trip Settings: Selected to coordinate with generator thermal damage curve.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

5. Enclosure: Provide NEMA 4X stainless steel enclosure for breakers mounted exposed to weather.

B. Generator Disconnect Switch: Molded-case type, 100 percent rated.
   1. Rating: Matched to generator output rating.
   2. Shunt Trip: Connected to trip switch when signaled by generator protector or by other protective devices.
   3. Enclosure: Provide NEMA 4X stainless steel enclosure for breakers mounted exposed to weather.

C. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:
   1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
   2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
   3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
   4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

D. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications. Alarm shall be remotely monitored by BMS.

2.07 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Drip proof.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
   1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

K. Sub transient Reactance: 12 percent, maximum.

2.08 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, weatherproof steel housing or NEMA 4X stainless steel, wind resistant up to 100 mph. Roof shall be pitched for drainage and overlapping on all sides. Exhaust pipe opening shall be fitted watertight sealing material. Provide a drip shield around the exhaust pipe opening. Multiple panels shall be lockable and provide adequate access to components

requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure and accessible by opening the hinged panel doors. Panel doors shall swing out 180 degrees.

B. Description: Prefabricated or pre-engineered walk-in enclosure of sufficient size to allow code required clearances on all sides and maintenance. Provide with the following features:
   1. Construction: Galvanized-steel, or metal-clad, integral structural-steel-framed building erected on concrete foundation. .
   2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.
   3. Seismic Design: Comply with ASCE 7, Chapter 13, as modified by 2016 California Building Code sections 1613A and 1616A.
   4. Enclosure shall have sound attenuation to reduce the noise to 70dB at 21 feet.
   5. Space Heater: Thermostatically controlled and sized to prevent condensation.
   6. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.
   7. Hinged Doors: With padlocking provisions.
   8. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.
   9. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
   10. Muffler Location: Within enclosure. Verify with Contracting Agency if enclosure walls need to be extended up to hide the external muffler so that it is not visible from grade.

C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
   1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
   2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

D. Lighting panelboard: Provide a 100A, 120/208V single phase 3 W NEMA 1 lighting panel with main circuit breaker inside the walk-in enclosure. Panel shall have bolt-on type main and branch breakers to serve branch circuits for block heaters, battery charger, interior and exterior lights, outlets, cooling fan plus minimum three spare 20A-1 pole breakers.

E. Interior Lights with Switch: Factory-wired, vapor proof-type fluorescent fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
   1. AC lighting system and connection point for operation when remote source is available.
   2. DC lighting system for operation when remote source and generator are both unavailable.

F. Convenience Outlets: Specification grade, factory wired GFCI. Arrange for external electrical connection.

2.09 MOTORS

A. General requirements for motors are specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.
   3. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
   4. Temperature Rise: Match insulation rating.

2.10 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of suffi-

cient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Standard neoprene
4. Durometer Rating: 50.
5. Number of Layers: 2.

B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
   1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch-thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
   2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

C. Provide vibration isolation and flexible connector materials for steel piping.

D. Provide vibration isolation and flexible connector materials for exhaust shroud and ductwork.

E. Vibration isolation devices shall not be used to accommodate misalignments or to make bends

2.11 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer. Verify with architect if a custom finish is required.

2.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
   1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
   1. One hour at 25 percent load.
   2. One hour at 50 percent load.
   3. Two hours at 75 percent load.
   4. Two hours at 100 percent load.

C. Test data shall be recorded and included in the maintenance manual. The following test data shall be recorded during factory and field tests:
   1. Voltage:
      a. Strip chart for 15 minutes at 75 percent load.
      b. Strip chart for 15 minutes at 100 percent load.
   2. Current:
      a. Strip chart for 15 minutes at 75 percent load.
      b. Strip chart for 15 minutes at 100 percent load.
   3. Frequency:
      a. Strip chart for 15 minutes at 75 percent load.
      b. Strip chart for 15 minutes at 100 percent load.
   4. Oil Pressure: Record in 15-minute intervals during test.
   5. Water Temperature: Record in 15-minute intervals during test.
   6. Water Pressure: Record in 15-minute intervals during test.
   7. Oil Temperature: Record in 15 minute intervals during test.
   8. KW Output: Record in 15-minute intervals during test.
   9. Test shall include testing with cold start including jacket heaters.

10. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
11. Voltage regulation.
12. Transient and steady-state governing.
13. Single-step load pickup.
14. Safety shutdown.
15. Observation of Factory Tests: Provide 14 days' advance notice of tests and opportunity for observation of tests by University's representative.

D. Report factory test results within 10 days of completion of test.
1. Report shall be reviewed, signed by the factory testing engineer. Include name of the engineer, date and location of testing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch on 4-inch-high concrete base. Secure sets to anchor bolts installed in concrete bases.

D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

C. Connect cooling-system water piping to engine-generator set and remote radiator heat exchanger with flexible connectors.

D. Connect engine exhaust pipe to engine with flexible connector.

E. Install exhaust-system piping. Extend to point of termination outside structure. Size piping according to manufacturer's written instructions.
1. Install condensate drain piping for engine exhaust system. Extend drain piping from low points of exhaust system and from muffler to condensate traps and to point of disposition.

F. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.04 IDENTIFICATION

A. Identify system components according to Section 23 05 53 "Identification for HVAC Piping and Equipment" and Section 26 05 53 "Identification for Electrical Systems."

B. Install a warning sign at the neutral to ground bond location indicating:

1. “WARNING: SHOCK HAZARD EXISTS IF GROUNDING ELECTRODE CONDUCTOR OR BONDING JUMPER CONNECTION IN THIS EQUIPMENT IS REMOVED WHILE ALTERNATE SOURCE IS ENERGIZED.”

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:
   1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
   3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
      a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
      b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
      c. Verify acceptance of charge for each element of the battery after discharge.
      d. Verify that measurements are within manufacturer's specifications.
   4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
   5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
   6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
   7. Exhaust Emissions Test: Comply with applicable government test criteria.
   8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases and verify that performance is as specified.
   9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
   10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at 3 locations on the property line, and compare measured levels with required values.

E. Coordinate tests with tests for transfer switches and run them concurrently.

F. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

G. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

J. Remove and replace malfunctioning units and retest as specified above.

K. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

L. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

M. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
   1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
   2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Contracting Agency's maintenance personnel to adjust, operate, and maintain packaged engine generators. Training shall be held on site after the generator set is complete and fully functional. Refer to Section 1-05.11 "Facility Startup, Testing, and Training."

END OF SECTION 26 32 13

This page intentionally left blank

SECTION 26 36 00
TRANSFER SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Transfer switches rated 600 V and less, including the following:
   1. Automatic transfer switches.
   2. Bypass/isolation switches.
   3. Nonautomatic transfer switches.
   4. Remote annunciation systems.
   5. Remote annunciation and control systems.

1.02 RELATED DOCUMENTS

A. Section 26 00 00 “General Electrical Requirements.”

1.03 DEFINITIONS

A. ATS: Automatic Transfer Switch

B. BP/IS: Bypass switch and Isolation Switch

C. EMI: Electromagnetic interference.

D. LCD: Liquid-crystal display.

E. LED: Light-emitting diode.

F. NETA: InterNational Electrical Testing Association.

G. PC: Personal computer.

H. THD: Total harmonic distortion.

I. UPS: Uninterruptible power supply.

1.04 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Transfer switches shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances on all sides, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified. Drawings shall be drawn to scale (1/4”=1’-0”).
   1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and testing agency.

B. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control test reports.
1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 1-11 "Operation and Maintenance Data," include the following:
1. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.08 QUALITY ASSURANCE

A. American made products have been acceptable to the Owner. If non-domestic products are submitted, notice is hereby given that extensive testing shall be required to insure quality and conformance to the Specifications. Testing shall be done by a recognized lab acceptable to the Owner and all tests shall be witnessed by Owner's personnel. Testing procedures and test results shall be satisfactory to the Owner. Contractor shall be responsible for arranging the tests, for transportation, food and lodging for minimum of one Owner's representative to witness the test at the testing lab. Include all costs for the above in the bid.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 75 miles (120 kms of Project site, a service center capable of providing training, parts, and emergency maintenance repairs within 8 hours from the time of notification.

C. Contractor shall ensure that the manufacturer has a minimum of 15 years experience in the production of Emergency/Standby Engine Generators similar to the type and size specified in this project. Furnish a list of three (3) contacts for the three (3) similar projects completed within the last 5 years. Include name, tele no and email of the facility engineers.

D. Manufacturer shall have ISO 9001 or 9002 Certification.

E. Manufacturer shall have ability to readily provide replacement parts for a minimum period of ten (10) years, from the date of completion of the project. Furnish a letter from the manufacturer confirming the availability.

F. Transfer Switch shall be assembled at the manufacturer's own manufacturing facility using its own major devices (e.g., contactors) for the assembly. These devices shall be normally carried by the manufacturer as standard catalog items.

G. Transfer Switch shall comply with seismic zone applicable to the project. Unless otherwise indicated, verify requirements with Architect or Structural Engineer of Record (SEOR). Provide certified test reports of shake table test done by manufacturer on similar units.

H. Materials and equipment shall be new, modern in design and shall not have been in prior service except as required by factory tests. Major components (e.g. contactors, controls) shall be manufactured within six months of installation.

I. Source Limitations: Obtain automatic transfer switches and remote annunciator and control panels through one source from a single manufacturer switch, and accessories through one source from a single manufacturer through a local distributor.

J. Product Options: Drawings indicate size, profiles, and dimensional requirements of engine generators and are based on the specific system indicated. Refer to Part 2"Product Requirements."

K. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70, Article 100, and marked for intended location and application.

L. Testing Agency Qualifications: Member of NETA;
   1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of ten (10) years and has permanent in-house testing engineers and technicians involved with testing of transfer switches, switchboards, panelboards and OCPDs similar to those specified on this project.
   2. Testing company shall be located with 50 miles radius of the project.
   3. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing to supervise on-site testing specified in Part 3.

M. Comply with NEMA ICS 1.

N. Comply with NFPA 70.

O. Comply with NFPA 99.

P. Comply with NFPA 110.

Q. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.09 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
   1. Notify Construction Manager no fewer than fourteen (14) days in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.10 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
   a. Contactor Transfer Switches:
   b. Russellectric Inc
   c. Emerson; ASCO Power Technologies, LP.
   d. GE Zenith Controls.
   e. Kohler Power Systems; Generator Division.
   f. Onan/Cummins Power Generation; Industrial Business Group.

2.02 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location. Verify maximum available fault levels from the Short Circuit and Coordination Study.
2. Short-time withstand capability for three cycles.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Service-Rated Transfer Switch:
1. Comply with UL 869A and UL 489.
2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
3. In systems with a neutral, the bonding connection shall be on the neutral bus.
4. Provide removable link for temporary separation of the service and load grounded conductors.
5. Surge Protective Device: Service rated.
6. Ground-Fault Protection: Comply with UL 1008 for normal bus.
7. Service Disconnecting Means: Externally operated, manual mechanically actuated.

H. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

I. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

J. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.

K. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater. Thermostat shall be accessible for operator control.

L. Battery Charger: For generator starting batteries.
1. Float type rated 10 A.
2. Ammeter to display charging current.
3. Fused ac inputs and dc outputs.

M. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

N. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Section 26 05 53 "Identification for Electrical Systems."
1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

O. Enclosures: Free standing. general-purpose NEMA 250, Type 3R or 4X Stainless Steel, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

P. 1. Enclosure shall be fabricated from 12 gauge steel and shall be sized to exceed minimum bending space required by UL 1008. Doors shall have hinges and locking handle latch with provision for padlocks.

Q. 2. Contractors field wiring terminating within the enclosure shall comply with NFPA 70. Wires shall be permanently tagged near the terminal at each end with the wire number shown on approved shop drawings.

R. 3. The enclosure shall be constructed for convenient removal and replacement of contacts, coils, springs and control devices from the front without removal of main power conductors or removal of major components. The enclosure housing the ATS and BP/IS shall be constructed to protect personnel from energized components of the BO/IS during maintenance of the ATS.

2.03 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

G. Automatic Closed-Transition Transfer Switches: Include the following functions and characteristics:
   1. Fully automatic make-before-break operation.
   2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
   3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.
      a. Initiation occurs without active control of generator.
      b. Controls ensure that closed-transition load transfer closure occurs only when the 2 sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.
   4. Failure of power source serving load initiates automatic break-before-make transfer.

H. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

I. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.

J. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional,

time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.

K. Automatic Transfer-Switch Features:
   1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
   2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
   3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
   4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
   5. Test Switch: Simulate normal-source failure.
   6. Switch-Position Pilot Lights: Indicate source to which load is connected.
   7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
      a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
      b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
   8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
   9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
   10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
   11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
   12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
   13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
      a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
      b. Push-button programming control with digital display of settings.
      c. Integral battery operation of time switch when normal control power is not available.

2.04 BYPASS/ISOLATION SWITCHES

A. Comply with requirements for Level 1 equipment according to NFPA 110.

B. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
   1. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.
   2. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations.
   3. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
   4. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
   5. Operability: Constructed so load bypass and transfer-switch isolation can be performed by 1 person in no more than 2 operations in 15 seconds or less.
   6. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
   7. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

2.05 NONAUTOMATIC TRANSFER SWITCHES

A. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." Switch shall be capable of transferring load in either direction with either or both sources energized.

B. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." In addition, removable manual handle provides quick-make, quick-break manual-switching action. Switch shall be capable of electrically or manually transferring load in either direction with either or both sources energized. Control circuit disconnects from electrical operator during manual operation.

C. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.

D. Each switch shall be fully rated for the available fault current closing and withstand rating based on available fault current. Verify maximum available fault current from the Short Circuit and Coordination Study.

E. Nonautomatic Transfer-Switch Accessories:
   1. Pilot Lights: Indicate source to which load is connected.
   2. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternate-source sensing circuits.
      a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
      b. Emergency Power Supervision: Red light with nameplate engraved "Alternate Source Available."
   3. Unassigned Auxiliary Contacts: One set of normally closed contacts for each switch position, rated 10 A at 240-V ac.

2.06 REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:
   1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.

2. Switch position.
3. Switch in test mode.
4. Failure of communication link.
5. Fail to transfer.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
1. Indicating Lights: Grouped for each transfer switch monitored.
2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
4. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.07 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

A. Functional Description: Include the following functions for indicated transfer switches:
1. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Indication of switch position.
3. Indication of switch in test mode.
4. Indication of failure of digital communication link.
5. Key-switch or user-code access to control functions of panel.
6. Control of switch-test initiation.
7. Control of switch operation in either direction.
8. Control of time-delay bypass for transfer to normal source.

B. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.

C. Remote Annunciation and Control Panel: Solid-state components. Include the following features:
1. Controls and indicating lights grouped together for each transfer switch.
2. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
3. Digital Communication Capability: Matched to that of transfer switches supervised.
4. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

2.08 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 EXECUTION

3.01 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."

B. Floor-Mounting Switch: Anchor to floor by bolting.
1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Section 26 05 29 "Hangers and Supports for Electrical Systems." Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."

C. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

D. Identify components according to Section 26 05 53 "Identification for Electrical Systems."

E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.02 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
   2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
   3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
      a. Check for electrical continuity of circuits and for short circuits.
      b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
      c. Verify that manual transfer warnings are properly placed.
      d. Perform manual transfer operation.
   5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
      a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
      b. Simulate loss of phase-to-ground voltage for each phase of normal source.
      c. Verify time-delay settings.
      d. Verify pickup and dropout voltages by data readout or inspection of control settings.
      e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
      f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
      g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
   6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
      a. Verify grounding connections and locations and ratings of sensors.

D. Testing Agency's Tests and Inspections:
   1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
   2. Perform each visual and mechanical inspection and electrical test stated in latest edition of NETA Acceptance Testing Specification. Certify compliance with test parameters.
   3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
      a. Check for electrical continuity of circuits and for short circuits.
      b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
      c. Verify that manual transfer warnings are properly placed.
      d. Perform manual transfer operation.
   4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
      a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
      b. Simulate loss of phase-to-ground voltage for each phase of normal source.
      c. Verify time-delay settings.
      d. Verify pickup and dropout voltages by data readout or inspection of control settings.
      e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
      f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
      g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
   5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
      a. Verify grounding connections and locations and ratings of sensors.

E. Coordinate tests with tests of generator and run them concurrently.

F. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

G. Remove and replace malfunctioning units and retest as specified above.

H. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
   1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
   2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Section 1-05.11 "Facility Startup, Testing and Training." Training shall be held on site after the all transfer switches are completely installed, tested and fully functional.

B. Coordinate this training with that for generator equipment.

END OF SECTION 26 36 00

This page intentionally left blank

SECTION 26 43 13

SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.02 RELATED REQUIREMENTS

A. Section 26 24 13 "Switchboards" for factory-installed SPDs.

B. Section 26 24 16 "Panelboards" for factory-installed SPDs.

1.03 RELATED DOCUMENTS

A. Section 26 00 00 “General Electrical Requirements.”

1.04 DEFINITIONS

A. I(nominal): Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   2. Product Certificates: For transient voltage surge suppression devices, signed by the product manufacturer certifying compliance with the following standards UL 1449 and UL 1283.
   3. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.06 INFORMATIONAL SUBMITTALS

A. Field quality-control reports. Include the following:
   1. Test procedures used.
   2. Test results that comply with the requirements.
   3. Failed test results and corrective action taken to achieve the requirements.

B. Sample Warranty: For manufacturer's special warranty.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For SPDs to include emergency, operation and maintenance manuals.

1.08 QUALITY ASSURANCE

A. If alternate manufacturer of products other than what are specified in this section are submitted, all necessary documents not limited to cut sheets, technical information, test reports from recognized testing labs and factory test reports shall be submitted to the satisfaction of the Contracting Agency/engineer to ensure quality and conformance to the specifications. Additional testing shall be undertaken if it is concluded by the Contracting Agency/engineer that the submitted test reports are either insufficient or do not include all tests necessary for product ac-

ceptance. The tests shall be conducted by a recognized lab acceptable to the Contracting Agency/engineer and all tests shall be witnessed by Contracting Agency's/engineer's personnel. All testing procedures and test results shall be satisfactory to the Contracting Agency/engineer. Contractor shall be responsible for arranging the tests, for transportation, food and lodging for minimum of one Contracting Agency's/engineer's representative to witness the test at the testing lab. Include all costs for the above in the bid.

B. Contractor shall ensure that the manufacturer has a minimum of 15 years experience in the production of Surge Protective Devices (SPDs) similar to the type and size specified in this project.

C. Manufacturer shall have ISO 9001 Certification.

D. Manufacturer shall have ability to readily provide replacement parts for a minimum period of ten (10) years, from the date of completion of the project. Furnish a letter from the manufacturer confirming the availability.

E. Surge Protective Devices (SPDs) shall be assembled at the manufacturer's own manufacturing facility using its own major components (e.g., trip units) for the assembly. These devices shall be normally carried by the manufacturer as standard catalog items.

F. Provide certified test reports of shake table test done by manufacturer on similar units.

G. Materials and equipment shall be new, modern in design and shall not have been in prior service except as required by factory tests. Controllers shall be manufactured within six months of installation.

H. Source Limitations: Obtain Surge Protective Devices (SPDs), overcurrent protective devices, components, and accessories, within same product category, through one source from a single manufacturer through a local distributor unless otherwise noted.

I. Comply with NFPA 70.

J. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

K. Product Options: Drawings indicate size, profiles, and dimensional requirements of Surge Protective Devices (SPDs) are based on the specific system indicated. Refer to Part 2 "Product Requirements."

L. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70, Article 100 and marked for intended location and application.

M. Testing Agency Qualifications: Member of NETA;
   1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of last ten (10) years and has permanent in-house testing engineers and technicians involved with testing of Surge Protective Devices, OCPDs, switches and breakers similar to those specified on this project.
   2. Testing company shall be located with 50 miles radius of the project.
   3. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing to supervise on-site testing specified in Part 3.
   4. Field Testing technician and supervisor shall have minimum ten (10) years experience in field testing of Surge Protective Devices (SPDs), OCPDs, switches and circuit breakers similar to the type and rating specified on this project.

1.09 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturers
   1. Schneider Electric Industries SAS
   2. ABB
   3. Advanced Protection Technologies Inc. (APT).
   4. Eaton Corporation.
   5. GE Zenith Controls.
   6. LEA International; Protection Technology Group.
   7. Leviton Manufacturing Co., Inc.
   8. PowerLogics, Inc..
   9. Siemens Industry, Inc.

2.02 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: UL Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449 and 1283

D. Comply with ANSI/IEEE C62.41-2002 and C62.5-2002

E. MCOV of the SPD shall be at least 125 percent of the nominal system voltage.

2.03 SERVICE ENTRANCE AND TRANSFER SWITCH SUPPRESSOR

A. SPDs: Comply with UL 1449, Type 1.

B. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1
   1. SPDs with the following features and accessories:
      a. Integral disconnect switch.
      b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
      c. Indicator light display for protection status. Visible indication display of proper SPD connection and operation shall be provided. The indicator light shall indicate which phase and module is fully operational. The status of each SPD module shall be monitored on the front cover of the enclosure. A push to test button shall ne provided to test each phase indicator.
      d. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status
      e. Surge counter. A surge counter shall be located on the diagnostic panel on the front cover of the enclosure. The counter shall be equipped with manual reset and battery backup to retain the memory upon loss of AC Power

C. SPD shall be tested with the ANSI/IEEE Category C_{High} exposure waveform (20kV-1.2/50μs, 10kA-8/20μ.

D. Pulse life test: Capable of protecting against and surviving 20,000 ANSI/IEEE Category C_{High} transients without failure or degradation of clamping voltage by more than 10%.

E. Comply with UL 1283.

F. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

G. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:
   1. Line to Neutral: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.

2. Line to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
3. Line to Line: 2000 V for 480Y/277 V and 1000 V for 208Y/120 V.

H. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
1. Line to Neutral: 700 V.
2. Line to Ground: 1000 V.
3. Line to Line: 1000 V.

I. SCCR: Equal or exceed 100 kA.

J. I(nominal) Rating: 20 kA.

2.04 PANEL SUPPRESSORS

A. SPDs: Comply with UL 1449, Type 1.
1. Include LED indicator lights for power and protection status.
2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status

B. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

C. Comply with UL 1283.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120V , three-phase, four-wire circuits shall not exceed the following:
1. Line to Neutral: 1200 V for 480Y/277 V and 700 V for 208Y/120 V
2. Line to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120 V
3. Neutral to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120 V
4. Line to Line: 2000 V for 480Y/277 V and 1000 V for 208Y/120 V.

E. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:
1. Line to Neutral: 700 V.
2. Line to Ground: 700 V.
3. Neutral to Ground: 700 V.
4. Line to Line: 1200 V.

F. SCCR: Equal or exceed 100 kA.

G. I(nominal) Rating: 20 kA.

2.05 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

B. Outdoor Enclosures: NEMA 250, Type 3R. Outdoor enclosure shall have temper proof screws and be lockable with a padlock.

2.06 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 24AWG, complying with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 12 AWG, complying with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:
   1. Power Wiring: Comply with wiring methods in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
   2. Controls: Comply with wiring methods in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.02 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
   1. Compare equipment nameplate data for compliance with Drawings and Specifications.
   2. Inspect anchorage, alignment, grounding, and clearances.
   3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.03 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Contracting Agency's maintenance personnel to operate and maintain SPDs.

END OF SECTION 26 43 13

This page intentionally left blank

SECTION 26 51 19
LED INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The following types of LED luminaires:
   1. Cylinder.
   2. Downlight.
   3. Highbay, linear.
   4. Highbay, nonlinear.
   5. Linear industrial.
   6. Lowbay.
   7. Parking garage.
   8. Recessed, linear.
   9. Strip light.
   10. Surface mount, linear.
   11. Surface mount, nonlinear.
   12. Suspended, linear.
   13. Suspended, nonlinear.
   14. Track Mounted, monopoint.

1.02 RELATED REQUIREMENTS

A. Section 26 09 43 “Network Lighting Controls”.”

1.03 RELATED DOCUMENTS

A. Section 26 00 00 “General Electrical Requirements.”

1.04 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Arrange in order of luminaire designation.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaires.
   4. Include emergency lighting units, including batteries and chargers.
   5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
   6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.
      a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
      b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.

D. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.
   1. Include Samples of luminaires and accessories involving color and finish selection.

E. Samples for Verification: For each type of luminaire.
   1. Include Samples of luminaires and accessories to verify finish selection.

F. Product Schedule: For luminaires and lamps, refer to light fixture schedule on plans.

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Luminaires.
   2. Suspended ceiling components.
   3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
   4. Structural members to which equipment and or luminaires will be attached.
   5. Initial access modules for acoustical tile, including size and locations.
   6. Items penetrating finished ceiling, including the following:
      a. Other luminaires.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.
      f. Ceiling-mounted projectors.
   7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of luminaire Product Test Reports: For each type of luminaire, for tests performed by DLC and as follows:
   1. Test reports complying with LM-79 (IES approved method for electrical and photometric measurements of Solid-State Lighting) providing total luminous flux, luminous intensity distribution, electrical power characteristics, luminous efficacy and color characteristics (CRI, CCT) shall be submitted.
   2. Test reports complying with LM-80 (IES approved standard for measuring lumen maintenance of LED light sources) providing lumen maintenance of LED light sources shall be submitted.
   3. ISTMT (IN SITU TEMPERATATURE MEASUREMENT TEST) – It is the measure of the LED source case temperature within the LED system (luminaire or lamp or it is the temperature of the LED within the luminaire. This measurement should be performed according to the temperature measurement point (TMP) indicated by the particular LED package

manufacturer. The temperature measured within the luminaire shall be within the temperature of the LM-80-08 LED source report.

4. All LED lifetime projections shall be made per TM-21-11 (approved method for taking LM-80 data and making useful LED lifetime projections).

E. Sample warranty.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.08 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
   1. Obtain Architect's approval of luminaires in mockups before starting installations.
   2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: 5 year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.01 REFER TO LIGHT FIXTURE SCHEDULE ON PLANS

2.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
   1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified ."

C. Ambient Temperature: 41 to 104 deg F (5 to 40 deg C).
   1. Relative Humidity: Zero to 95 percent.

D. Altitude: Sea level to 1000 feet.

2.03 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp characteristics:
      a. "USE ONLY" and include specific lamp type.
      b. Lamp diameter, shape, size, wattage, and coating.
      c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

2.04 MATERIALS

A. Metal Parts:
   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.

B. Steel:
   1. ASTM A 36/A 36M for carbon structural steel.
   2. ASTM A 568/A 568M for sheet steel.

C. Stainless Steel:
   1. 1. Manufacturer's standard grade.
   2. 2. Manufacturer's standard type, ASTM A 240/240 M.

D. Galvanized Steel: ASTM A 653/A 653M.

E. Aluminum: ASTM B 209.

2.05 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.06 LUMINAIRE SUPPORT

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.03 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Provide support for luminaire without causing deflection of ceiling or wall.
   4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaires:
   1. Secured to outlet box.
   2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
   3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaires:
   1. Attached to structural members in walls
   2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:
   1. Ceiling Mount:
      a. Two 5/32-inch diameter aircraft cable supports adjustable to 12 feet in length.
      b. Pendant mount with 5/32-inch diameter aircraft cable supports adjustable to 12 feet in length.
      c. Hook mount.
   2. Pendants and Rods: Where longer than 24 inches, brace to limit swinging.
   3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
   4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
   5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:
   1. Secure to any required outlet box.
   2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
   3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.04 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
   2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.06 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 26 09 43.16 "Addressable-Luminaire Lighting Controls."

B. Comply with requirements for startup specified in Section 26 09 43.23 "Relay-Based Lighting Controls."

3.07 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
   1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
   2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 51 19

SECTION 26 56 19
LED EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
   2. Luminaire supports.
   3. Luminaire-mounted photoelectric relays.

B. Related Requirements:
   1. Section 26 09 43 ”Network Lighting Controls”

1.02 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.
   1. Arrange in order of luminaire designation.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaire.
   4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
   5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project and testing procedures and criteria required by IES LM-79 and LM-80.
      a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
      b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
   6. Wiring diagrams for power, control, and signal wiring.
   7. Photoelectric relays.
   8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Sustainable Design Submittals:
   1. "BUG ratings" Light Pollution Reduction for both uplight and light trespass.

PART 2 PRODUCT DATA INDICATING LUMINAIRE IS CERTIFIED BY DESIGN LIGHTS CONSORTIUM

A. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.

B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

C. Delegated-Design Submittal: For luminaire supports.
   1. Include design calculations for luminaire supports and seismic restraints.

2.02 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Luminaires.
   2. Structural members to which equipment and luminaires will be attached.
   3. Underground utilities and structures.
   4. Existing underground utilities and structures.
   5. Above-grade utilities and structures.
   6. Existing above-grade utilities and structures.
   7. Building features.
   8. Vertical and horizontal information.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of the following:
   1. Luminaire.
   2. Photoelectric relay.

E. Test reports complying with LM-79 (IES approved method for electrical and photometric measurements of Solid-State Lighting) providing total luminous flux, luminous intensity distribution, electrical power characteristics, luminous efficacy and color characteristics (CRI, CCT) shall be submitted.Test reports complying with LM-80 (IES approved standard for measuring lumen maintenance of LED light sources) providing lumen maintenance of LED light sources shall be submitted.

F. ISTMT (IN SITU TEMPERATATURE MEASUREMENT TEST) – It is the measure of the LED source case temperature within the LED system (luminaire or lamp or it is the temperature of the LED within the luminaire. This measurement should be performed according to the temperature measurement point (TMP) indicated by the particular LED package manufacturer. The temperature measured within the luminaire shall be within the temperature of the LM-80-08 LED source report.

G. All LED lifetime projections shall be made per TM-21-11 (approved method for taking LM-80 data and making useful LED lifetime projections).

H. Product Test Reports: For each luminaire, for tests performed a qualified testing agencyas follows:
   1. Test reports complying with LM-79 (IES approved method for electrical and photometric measurements of Solid-State Lighting) providing total luminous flux, luminous intensity distribution, electrical power characteristics, luminous efficacy and color characteristics (CRI, CCT) shall be submitted.
   2. Test reports complying with LM-80 (IES approved standard for measuring lumen maintenance of LED light sources) providing lumen maintenance of LED light sources shall be submitted.

3. ISTMT (IN SITU TEMPERATATURE MEASUREMENT TEST) – It is the measure of the LED source case temperature within the LED system (luminaire or lamp or it is the temperature of the LED within the luminaire. This measurement should be performed according to the temperature measurement point (TMP) indicated by the particular LED package manufacturer. The temperature measured within the luminaire shall be within the temperature of the LM-80-08 LED source report.
4. All LED lifetime projections shall be made per TM-21-11 (approved method for taking LM-80 data and making useful LED lifetime projections).

I. Source quality-control reports.

J. Sample warranty.

2.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

2.04 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

2.05 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

F. Mockups: For exterior luminaires, complete with power and control connections.
1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

2.06 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

2.07 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

2.08 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures, including luminaire support components.
      b. Faulty operation of luminaires and accessories.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: 5-years from date of Substantial Completion.

PART 3 PRODUCTS

3.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
   1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

3.02 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598 and listed for wet location.

E. Lamp base complying with IEC 60061-1.

F. Bulb shape complying with ANSI C79.1.

G. CRI of minimum 80. CCT of 4000K.

H. L70 lamp life of 50,000 hours.

I. Lamps dimmable from 100 percent to 0 percent of maximum light output.

J. Internal driver.

K. Nominal Operating Voltage: 277 V ac.

L. In-line Fusing: On the primary for each luminaire.

M. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.

N. Source Limitations: Obtain luminaires from single source from a single manufacturer.

O. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

3.03 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay.

Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

3.04 LUMINAIRE TYPES

A. Area and Site:
   1. Luminaire Shape: Round or Square
   2. Mounting: See plans.
   3. Luminaire-Mounting Height: See plans.
   4. Distribution: See plans.
   5. Diffusers and Globes: Coordinate with Architect
   6. Housings:
      a. Extruded-aluminum housing and heat sink.
      b. See plans or coordinate with Architect for finish.

B. Canopy:
   1. Shape: Rectangular
   2. Dimensions:4 feet.
   3. Diffusers and Globes: Coordinate with Architect
   4. Housings:
      a. Extruded-aluminum housing and heat sink.
      b. See plans or coordinate with Architect for finish.

C. Roadway:
   1. Luminaire-Mounting Height: See plans.
   2. Mounting Type:See Plans
   3. Distribution: Type II, Type IV
   1. Diffusers and Globes: Coordinate with Architect
   4. Housings:
      a. Extruded-aluminum housing and heat sink.
      b. See plans or coordinate with Architect for finish.

3.05 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:
   1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   2. Glass: Annealed crystal glass unless otherwise indicated.
   3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.

G. Housings:
   1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.

2. Provide filter/breather for enclosed luminaires.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp characteristics:
      a. "USE ONLY" and include specific lamp type.
      b. Lamp diameter, shape, size, wattage and coating.
      c. CCT and CRI for all luminaires.

3.06 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
   2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
   3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
   4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
      a. Color: See plans, or as selected by Architect.

3.07 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 4 EXECUTION

4.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, ceilings for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

4.02 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

4.03 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Support luminaires without causing deflection of finished surface.
   4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls.

G. Wiring Method: Install cables in raceways. Conceal raceways and cables.

H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.

I. Coordinate layout and installation of luminaires with other construction.

J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

K. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and Section 26 05 33 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

4.04 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

4.05 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

4.06 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
   2. Verify operation of photoelectric controls.

C. Illumination Tests:
   1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
      a. IES LM-5.
      b. IES LM-50.
      c. IES LM-52.
      d. IES LM-64.
      e. IES LM-72.
   2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

4.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

4.08 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
   1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
   2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 56 19

SECTION 27 05 00

REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide a standard defining the structured communications cabling systems to be installed within customer facility. The goal is to accomplish this in the most economic and systematic fashion possible, and in a manner compliant with the latest codes, cabling standards and industry best practices.

B. Scope of Work Compliance.

C. Contractor Qualifications.

D. Warranty.

E. Safety.

F. Working Conditions.

1.02 GENERAL TERMS AND CONDITIONS.

A. General Contractor is responsible for all required Division 27 scope of Work and shall ensure all communication sub-tier contractors adhere to the qualifications set forth in all project Division 27 specifications including project experience and certifications.

B. Prices quoted shall be all-inclusive and represent a complete fully-engineered system installation at the Project site as contemplated by and detailed in the drawing package and in accompanying specifications.

C. Omissions in the specification of any provision herein described shall not be construed as to relieve the Contractor of any responsibility or obligation requisite to the complete and satisfactory delivery, installation, operation and support of any and all systems, equipment or services. Correction of any omission on the part of the Contractor, either due to misinterpretation of this specification or any other conditions of the project, shall be the responsibility of the Contractor and shall not result in any contract modification or additional costs to Contracting Agency.

D. Where conflicts and/or irregularities occur between project documents, specifications, drawings, and/or applicable codes, rules, regulations, ordinances, standards, guidelines and practices, the more stringent requirement shall apply as reasonably determined by Contracting Agency or government agency inspector.

E. This specification represents the design intent for the project communicated by way of narrative descriptions of intended functionality and single line or detail drawings indicating likely equipment connectivity to achieve that functionality. The designs in this specification do not represent fully engineered technical solutions. Contractors are required to review the designs presented in the project documents closely, submit any questions and clarifications regarding the design intent through the RFI process and develop their own engineered solutions representing a fully functional turn-key solution in their bid responses.

F. The scope of this project includes the complete system engineering, procurement, fabrication, installation, programming, testing, training and warranty.

G. Proposed solutions shall be based on the designs communicated in the specifications, but shall include any additional equipment, materials, software, licenses and/or labor required for the Contractor to deliver a fully functional turn-key system solution that meets intended operational performance requirements.

H. It is the responsibility of the Contractor awarded this project to ensure that all quantities, materials, labor, licenses, permits, sales taxes and any and all other costs to provide a turn-key project are included in their bid.

I. Floor plans, drawings, elevation drawings, and other drawings received by the Contractor as part of the construction process are hereby incorporated into this document by reference. It is the responsibility of the Contractor to ensure that amounts and lengths of cabling and pathways

are correct, and that all materials and labor are included to install the system per the drawings and these specifications.

J. Permits, licenses, applicable sales taxes, insurance requirements, payment/performance bond costs, and other miscellaneous costs are the responsibility of the Contractor and shall be included in the contract price and this scope of Work. Such items are to be listed separately on pricing sheets, if provided. Copies of all required permits, licenses, insurance requirements and bond(s) are to be delivered to Contracting Agency prior to commencement of any work.

K. Installation Schedule and Coordination: Contractor shall take the fast-track nature of this project and potential requirement for installation/work schedule adjustments and quick turnarounds into consideration in constructing this project as Contracting Agency will NOT entertain or agree to added-cost change orders associated with scheduling changes.

L. Work will need to be closely coordinated with architect, City Personnel, GC, MEP contractors, structural Contractor and all low-voltage contractors and each of their respective schedules.

M. This will be a turn-key Project. Any item of the equipment or material not specifically addressed on the drawings, specifications or elsewhere in Division 27 specifications documents, but required to provide complete and functional systems as contemplated and/or specified herein, shall be provided at no additional charge to Contracting Agency in a quantity and quality consistent with other specified items.

N. Coordination with Project Design Team: The build contractor will be responsible for coordinating all communications cabling infrastructure requirements, including review of existing site conditions, review and coordination of electrical power and grounding requirements, conduits and back boxes, structural support requirements, and coordination.

O. Assembly: The Contractor shall procure and assemble all hardware and equipment and any additional materials as required to deliver the completely functioning communications cabling system.

P. Installation: The Contractor shall install all equipment, inter-rack and intra-rack cable, wiring of equipment, connectors, panels, plates, and other material at the Project site.

Q. Testing and Adjustment: The Contractor shall perform all tests and adjustments, furnish all test equipment necessary and perform all Work required to properly configure the systems and to verify their performance in accordance with the information in this document and the design-build integrator's approved engineered designs.

R. Warranty: The Contractor shall warrant the installed system in accordance with the terms of this document and accompanying contractual documents.

1.03 RELATED DOCUMENTS

A. All divisions of the specification and general provisions of the Construction Documents.

B. Architectural, mechanical, electrical, and all technology drawings including but not limited to Telecommunication Drawings.

C. Project Basis of Design document for low-voltage/signal systems (a.k.a. Technology Systems including but not limited to; IP Network, Wireless IP Network, Paging, Category 6A Structured Cabling Solution

D. Refer to structural seismic requirement design documents specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

1.04 REFERENCES

A. Abbreviations and Acronyms:

1.	A/E:	Architect / Engineer (designer)
2.	BICSI:	Building Industry Consulting Service International
3.	EIA:	Electronics Industry Alliance
4.	ELFEXT	Equal Level far End Cross Talk
5.	FTP	Foiled Twisted Pair
6.	IDF:	Intermediate Distribution Facility
7.	ILEC/LEC:	Incumbent Local Exchange Carrier

8. ISP: Inside Plant
9. IT: Information Technology
10. BDF: Building Distribution Frame
11. LOMMF: Laser Optimized Multi-Mode Fiber
12. MDF: Main Distribution Facility
13. MPOE: Minimum Point of Entry
14. NEXT Near End Cross Talk
15. OSP: Outside Plant
16. PSELFEXT: Power Sum Equal Level Far End Cross Talk
17. PSNEXT: Power Sum Near End Cross Talk
18. RCDD: Registered Communications Distribution Designer
19. TBD: To Be Determined
20. TCIM: Telecommunication Cabling Installation Manual
21. TDMM: Telecommunications Distribution Methods Manual
22. TIA: Telecommunications Industry Association
23. UTP: Unshielded Twisted Pair
24. WAP: Wireless Access Point

1.05 APPLICABLE REGULATORY REFERENCES

A. Contractor is responsible for knowledge and application of current versions of all applicable Standards and Codes. In cases where listed Standards and Codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.
   1. ANSI/TIA:
      a. TIA-526-7 (OFSTP-7) (July 2015) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
      b. TIA-526-14-C (April 2015) (OFSTP-14) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
      c. ANSI/TIA/EIA-598-D (2018) Optical Fiber Cable Color Coding
      d. ANSI/TIA-568-C.0 (December 2015) Generic Telecommunications Cabling for Customer Premises
      e. TIA-568-C.0-1 (September 2012) Generic Telecommunications Cabling for Customer Premises-Addendum 1, Updated Reference for Balanced Twisted-Pair Cabling
      f. ANSI/TIA-568-C.1 (February 2012) Commercial Building Telecommunications Cabling Standards
      g. TIA-568-C.1-2 (November 2014) Commercial Building Telecommunications Cabling Standard, Addendum 2 General Updates
      h. ANSI/TIA-568-C.2 (June 2016) Balanced Twisted Pair Communications Cabling and Components Standards
      i. ANSI/TIA-568-C.3 (June 2011) Optical Fiber Cabling Components Standard
      j. ANSI/TIA-568-C.3-1 (December 2011) Optical Fiber Cabling Component Standard-Addendum 1, Addition of OM4 Cabled Optical Fiber and array connectors
      k. ANSI/TIA-568D – Series Generic Telecommunications Cabling for Customer Premises (that includes Cat6A, OM5, and other cable performance enhancements)
      l. ANSI/TIA-1183-A (2017) Test Fixtures for Balun-Less Measurements of Balanced Components and Systems
      m. ANSI/TIA-568-C.4 (July 2011) Broadband Coaxial Cabling Components Standard
      n. ANSI/TIA-942-B (2020) Telecommunications Infrastructure Standard for Data Centers
      o. TIA-569-E (2019) Telecommunications Pathways and Spaces
      p. ANSI/TIA-606-C (2017) Administration Standard for Telecommunications Infrastructure
      q. TIA-607-D (2019) Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises
      r. TIA-758-C (2018) Customer-Owned Outside Plant Telecommunication Infrastructure Standard

s. TIA-1152-A (2016) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
t. ANSI/TIA-862-B (February 2016) Structured Cabling Infrastructure Standard for Intelligent Building Systems.
u. TIA-570-D (2018) Residential Telecommunications Infrastructure Standard
v. TIA-1005-A (June 2012) Industrial Telecommunications Infrastructure Standard for Manufacturing, Process & Refining
w. ANSI/TIA-1005 (January 2015) Telecommunications Infrastructure Standard for Industrial Premises
x. TIA-1005-1 (May 2012) Telecommunications Infrastructure Standard for Industrial Premises; Addendum 1 - Industrial Pathways and Spaces
y. TIA-1179-A (July 2018) Healthcare Facility Telecommunications Infrastructure Standard.

2. ISO/IEC
   a. ISO 11801-6 (2017) - Generic Cabling for Customer Premises
   b. ISO/IEC TR 14763-3-2 (2016) - Information technology -- Implementation and operation of customer premises cabling -- Part 2-1: Planning and installation - Identifiers within administration system.
3. Electric Codes
   a. California Electrical Code, CEC (2019)
   b. ANSI/NFPA 70-2017, National Electrical Code (NEC)
   c. ANSI/IEEE C2-207, National Electrical Safety Code®
4. OSHA Standards and Regulations – all applicable
5. 2019 California Title 24
   a. 2019 California Administrative Code, Title 24 Part 1
   b. 2019 California Building Code, Title 24 Part 2
   c. 2019 California Electrical Code, Title 24 Part 3
   d. 2019 California Mechanical Code, Title 24 Part 4
   e. 2019 California Plumbing Code, Title 24 Part 5
   f. 2019 California Energy Code, Title 24 Part 6
   g. 2019 California Fire Code, Title 24 Part 9
   h. 2019 Green Building Standard Code, Title 24 part 11
   i. 2019 California Standard Code, Title 24 Part 12
6. Local Codes and Standards – all applicable
7. BICSI
   a. Telecommunications Distribution Methods Manual, 14th Edition (2021)
   b. AV Design Reference Manual, 1st Edition (2015)
   c. Network Design Reference Manual, 7th Edition (2015)
   d. Network Systems and Commissioning (NSC) reference, 1st Edition (2015)
   e. Outside Plant Design Reference Manual, 6th Edition (2018)
   f. Wireless Design Reference Manual, 3rd Edition (2015)
   g. Electronic Safety and Security Design Reference Manual, 4th Edition. (2014)
   h. Information Technology Systems Installation Methods Manual (ITSIMM), 6th Edition
   i. ANSI/BICSI 001-2017, Information Transport Systems Design Standard for K-12 Educational Institutions
   j. ANSI/BICSI 002-2019, Data Center Design and Implementation Best Practices
   k. ANSI/BICSI 003-2014 Building Information Modeling (BIM) Practices for Information Technology Systems
   l. BICSI 004-2018, Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
   m. ANSI/BICSI 005-2016 – Electronic Safety and Security (ESS) System Design and Implementation Best Practices
   n. ANSI/BICSI 006-2020 Distributed Antenna System (DAS) Design and Implementation Best Practices

o. ANSI/BICSI 007-2017 Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises
p. ANSI/BICSI 008-2018 Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices
q. ANSI/BICSI 009-2019 Data Center Operations and Maintenance Best Practices
r. ANSI/BICSI N1-19 Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure. Formally known as - ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
s. ANSI/BICSI N2-17 Practices for the Installation of Telecommunications and ICT Cabling Intended to Support Remote Power Applications
t. ANSI/BICSI N3-20 Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure – formally know as - NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
u. BICSI G1-17 ICT Outside Plant Construction and Installation: General Practices

8. Anywhere cabling Standards conflict with electrical or safety Codes, Contractor shall defer to NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.
9. Knowledge and execution of applicable codes is the sole responsibility of the contractor.
10. Any code violations committed at the time of installation shall be remedied at the contractor's expense.

1.06 SCOPE OF WORK

A. General project information:
1. These Specifications and associated drawings are the governing document for the installation of the telecommunications infrastructure and includes project descriptions, specified and recommended products, installation and project management methods, the scope of Work and elevation drawing specifications.
2. Through this division specification document, Kitsap will be referred to as the Contracting Agency.
3. Contracting Agency wishes to contract with a General Contractor, who will sub-tier the supplier/contractor ("ICT-Information, Communication Technology and Physical Security") to provide, install, test and warranty a complete turn-key a Cable Infrastructure System and Security System for the Contracting Agency's (Kitsap), the "Project" per the scope of Work and specifications stated herein. This inquiry implies no obligation on the part of Contracting Agency. Contractor shall bear all costs and expenses incurred in preparing a response a Request for Proposal ("RFP") and subsequent award of project, it being understood and agreed that Contracting Agency accepts no responsibility for any costs and/or expenses incurred by winning Contractor in preparing and submitting such response.
4. The existing North District Road Maintenance facilities serving north Kitsap County have been deemed functionally obsolete by Kitsap County Public Works (KCPW). KCPW requires a new Road Maintenance and Operations facility that will also include administrative offices, vehicle maintenance bays, an equipment and vehicle wash bay, a vehicle and equipment fueling station, and a moderate risk waste (f) collection site. The purpose of the HHWCF collection site is to provide a collection point for household hazardous waste (HHW) from North Kitsap County and Bainbridge Island residents. The building will consist of the following:
a. Both the new first floor of the MRWF and Maintenance buildings will have BDFs that will support the network requirements for the site.
b. Describe Room types to be in scope
c. Reference Div 28 security systems
d. Describe MDF/BDF/IDF room build out.
e. Describe backbone infrastructure and cable as needed.
f. Describe Horizontal cable infrastructure as needed.

B. Purpose:
   1. This specification defines quality standards and practices common to all network cabling for the project. In addition, said project will have Requests for Proposals (RFP), associated drawings and requirements pertaining to their specific environments. Such collateral will be referred to in this document as "Project Specific Documentation" or simply "Construction Documents".
   2. Voice and Data Networks encompass a broad spectrum of technologies and are distributed into project internal spaces. Installed cables will be used for Ethernet, high and low speed data applications, used in analog and digital voice, not to exclude other future Voice/Data technologies. This specification will include indoor/outdoor cable installations, and backbone cabling, telecommunications closet and equipment cabling, equipment hardware as well as routing and support infrastructure.
   3. It is the responsibility of the installing Contractor to evaluate these general recommendations and adapt them effectively to actual projects. Contractor is responsible for identifying and bringing to the attention of any design directions that may be in conflict or otherwise improved. All such conflict resolutions shall be in writing from A/E or Contracting Agency.
   4. Note that while many portions of this global specification are addressed to "The contractor", these requirements apply equally to anyone doing the network cabling and infrastructure work within, whether those persons are outside contractors or persons directly employed by the Contracting Agency.
   5. Contractor shall be solely responsible for all parts, labor, testing, documentation and all other associated processes and physical apparatus necessary to turn-over the completed system fully warranted and operational for acceptance by A/E.
   6. This specification includes structured cabling design considerations, product specifications and installation guidelines for low-voltage network systems and associated infrastructure including, but not limited to:
      a. Cabling Sub-system 1 – Horizontal
         1) Category 6A cable
         2) Work area (equipment outlet) appliances and configuration
         3) Horizontal Pathways
         4) Copper Patching
         5) Powered fiber cabling and infrastructure
      b. Backbone Cabling
         1) Interbuilding backbone – Copper and Fiber
         2) Patching / Cross-connect – Copper and Fiber
      c. Telecommunications Spaces
         1) Telecommunications Room Requirements
         2) Racks and Cabinets
         3) Overhead Pathways
      d. Communications Grounding Systems
      e. Communications Labeling and Administration

C. Scheduling:
   1. Contract Documents and the overall construction schedule must be carefully reviewed to determine all required interfacing and timing of the Work. All such documents shall be available through the General Contractor or Construction Manager.
   2. Project schedule shall include, but are not limited to, the following task sequence:
      a. New Server Room, IDF Construction and buildout.
      b. Conduit infrastructure; including vaults/pull box install and conduit duct banks.
      c. Individual Building Pathway Installation.
      d. Building Category 6A Cable installations; includes install, termination, labeling, testing, as-built and warranty documentation.
      e. Wireless Access Points.
      f. New backbone fiber optic cabling installations: includes install, termination, labeling, testing, as built and warranty documentation.
      g. Service provider cabling and equipment installation.

h. Service provider completion and commissioning.

D. Coordination:
1. Install and coordinate the telecommunications cabling work in cooperation with other trades installing interrelated Work. Before installation, make proper provisions to avoid interference in a manner accepted by the architect. Any repairs or changes made necessary in the contract work, caused by the sub-contractor's neglect, shall be made by the sub-contractor at their own expense

E. Project Scoping from Basis of Design:
1. The Contractor shall use all input from Kitsap current technology standards for a complete functioning turn-key technology solution
2. The building shall contain a dedicated main IDF/Data Room housing building network equipment racks, terminal backboards, and other telecommunication equipment. A Cat 6A structured cabling system will be provided per the Contracting Agency's standards extending from the respective IDF facility to outlets serving workstations, printers, copiers, fax machines, wireless access points (WAPs), other devices/locations as determined by the Contracting Agency. Wireless LAN coverage will be provided for exterior building spaces as coordinated with the Contracting Agency. All final WAP locations and coverages are to be coordinated with and determined by the Contracting Agency.

1.07 SYSTEM DESCRIPTION AND GENERAL RESPONSIBILITIES

A. The Work to be performed under this contract includes the furnishing of all labor, materials, and equipment for an industry compliant telecommunications pathway and spaces building system, analog and optical fiber backbone cabling solution, category six enhanced (6A) manufacturer compliant structured cabling systems with extended performance and replacement warranty, for the systems required by project. These systems include data network connections, VoIP instruments, and headend interfaces, project systems requirements, wireless and Wi-Fi access, Paging. Video surveillance system, a physical access control system. Work shall include all provisions of new electronics controls systems, including physical access control, duress alarm, video surveillance, and audio. The portion of the Work is to be bid as an optional add alternate, and the Contracting Agency may or may not choose to execute this Work under the contract.

B. Combined Prescriptive and Performance Design Requirements
1. Division 27 includes a combination of prescriptive and performance specifications. Compliance with the performance specifications, as well as coordination and integration of the prescription requirements, will require substantial design work on the part of the Contractor.
2. The performance requirements are intended to establish overall system performance requirements, satisfy the operational requirements, and establish the inter-coordination requirements for the Division 27 systems.
3. The prescriptive requirements establish the minimum quality, characteristics, and types of components, equipment, and materials to be used to achieve the stated system performance requirements. The Contractor is advised, however, that prescriptive specifications have not been provided to satisfy all of the specified performance requirements.
4. The Contractor shall carefully consider all of the requirements for each of the Division 27 systems when preparing its bid. Any questions regarding the intent of these requirements, the scope of the systems, or their coordination requirements must be submitted in writing prior to bidding in accordance with the Instructions to Bidders. The Contractor shall have no claim for either extra compensation or extra time on the grounds that it did not understand the scope or the requirements of the Division 27 work, and/or the coordination requirements of the Division 27 work with the Work of the other Divisions.
5. Compliance with the project requirements will be progressively monitored and adjusted through the submittal process, installation period, and performance verification testing.

C. Drawing Interpretation
1. The drawings are diagrammatic and indicate the general arrangement of systems and equipment unless indicated otherwise by dimensions or detailed drawings. The Drawings installation and schematic diagrams and symbols to outline the Work to be provided.

These drawings do not have any dimensional significance nor do they delineate every item required for the intended Work. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete Work are excluded.

2. The Work shall be provided in accordance with the intent expressed on the Drawings and Specifications and in conformance with the actual building architectural and structural conditions. When in conflict, field conditions take precedence over the Contract Documents.
3. The meaning of abbreviations shall be the same, whether in lower case letters or without periods.
4. The use of words in the singular shall not be considered as singular where other indications denote that more than one item is referred to.
5. Details that appear on the Contract Documents, which are specific with regard to the dimensioning and positioning of the Work, are intended only for the purpose of establishing general feasibility. They do not replace engineering or field coordination by the Contractor for the Work.

D. Provide all parts and equipment for a complete and operational system for the Work of Division 27 as described herein and shown on the drawings.

E. Furnish and install all trenching and backfill, duct banks, conduits, raceways, sleeves, boxes, gutters, shelves, enclosures, shelf and enclosure supports, backboards, pull ropes (in unused or spare conduits) required to make all systems fully operational, including components not shown on the Drawings, but necessary for fully operational systems.

F. Furnish, install, terminate, test, dress, and identify all wire and cable required to make systems fully operational, including all wire and cabling not shown on the Drawings, but necessary for fully operational systems.

G. Recognize that the Work entails integration between individual systems, as well as the design and implementation of many systems and component interfaces. Take full responsibility for the complete design, installation, and performance of the total integrated system, including integration between systems and various interfaces, in order to achieve the specified operational features and system performance requirements.

H. Fully test the systems, demonstrate their satisfactory operation, and train maintenance and operating personnel, as specified in this Section and the Sections governed by this Section.

1.08 CONTRACTOR QUALIFICATIONS

A. General:
1. Contractor shall have at least 5 years of experience installing and testing structured cabling systems.
2. Contractor shall employ at least one BICSI Registered Communication Distribution Designer (RCDD), and the RCDD shall sign-off on all designs offered, including stamping the design with their current BICSI/RCDD stamp.
3. Contractor shall have the responsibility to obtain any of the necessary permits, licenses, and inspections required for the performance of data, voice, and fiber optic cable installations.
4. Contactor shall be a current manufacturer Certified Installer certificate. A copy of corporate certificate shall be included with quote.
5. Contractor shall have service facilities within 50 miles of project location.
6. At least 75 percent of the technicians on the job shall have a current manufacturer Certified Copper Technicians certificate to install manufacturer Copper Distribution Systems.
7. At least 75 percent of the technicians installing any Fiber Distribution Systems shall have a current manufacturer Certified Fiber Technicians certificate to install Fiber Distribution Systems.
8. The Telecommunications contractor shall provide a project manager to serve as the single point of contact to manage the installation, speak for the Contractor and provide the following functions:
   a. Initiate and coordinate tasks with the Construction Manager and others as specified by the project schedule.
   b. Provide day to day direction and on-site supervision of Contractor personnel.

c. Ensure conformance with all contract and warranty provisions.
d. Participate in weekly site project meetings.
e. This individual shall remain project manager for the duration of the project. The Contractor may change Project Manager only with the written approval of A/E.

B. References:
1. Communications Contractor shall provide with bid a list of three reference accounts where similar Data, Voice, Fiber Optic Cable, and related migration/cutover equipment installation work was performed within the last year or twelve-month period.

C. Insurance Requirements:
1. Contractor shall be insured and shall provide with bid a Certificate of Indemnification, Certificate of Insurance, and meet all required insurance and licensing policies as specified by A/E Risk Management Division and any Federal, State, and local organization pertaining to data, voice and fiber optic cable installation.
2. Contractor's vehicles brought onto project properties, shall comply with all requirements of all Federal, State, and local agencies. Vehicles shall meet current DOT, state and local, safety inspections where required.

D. Termination of Services:
1. Contracting Agency or A/E reserves the right to terminate the Communication Contractor's services if at any time the A/E determines the Communication Contractor is not fulfilling their responsibilities as defined within this document.
2. Contractor's appearance and work ethics shall be of a professional manner, dress shall be commensurate with Work being performed.
3. Dress displaying lewd or controversial innuendos shall strictly be prohibited.
4. Conduct on project property shall be professional in nature.
5. Any person in the Contractor's employ working on a project considered by to be incompetent or disorderly, or for any other reason unsatisfactory or undesirable, such person shall be removed from Work on the project.
6. The Communications Contractor shall be restricted from the premises and compensated for the percentage of Work completed satisfactorily.

E. Other Contractor Responsibilities
1. Contractor is responsible for the removal and disposal of all installation and construction debris created in the process of the job. All work areas shall be cleaned at the conclusion of the workday and no tools or materials shall be left in a manner as to pose a safety hazard.
2. Contractor shall remove all abandoned cable per Article 800 of the National Electrical Code and per TIA and BICSI standards, recycling these materials where possible. This is mandatory; Contractors shall consider this when placing bids.
3. Contractor shall abide by the regulations set by A/E or Contracting Agency Security Department pertaining to access to and conduct while on project property and shall obey speed limits and parking regulations.

1.09 SYSTEM PERFORMANCE WARRANTY

A. General
1. Contractor shall provide a manufacturer System Warranty on all copper and fiber permanent cabling links.
2. This is a system performance warranty guaranteeing for a minimum of 20 years from acceptance that the installed system shall support all data link protocols for which that copper Category (6A) or fiber OS designation is engineered to support according to IEEE and TIA standards.
3. The manufacturer System Warranty may be invoked only if the cabling channel links are comprised of manufacturer connectivity and approved by the manufacturer. Patch cords shall be same manufacturer of cable.
4. Upon acceptance of Warranty, manufacturer will mail a notification letter to the installer and a notification letter and warranty certificate to A/E.

B. Contractor Warranty Obligations
   1. Installation firm shall be a current manufacturer Certified Installer in good standing and shall include a copy of the company certification with the bid.
   2. Contractor shall name a supervisor to serve on site as a liaison responsible to inspect and assure all terminations are compliant to factory methods taught in manufacturer Technician Certification Training and according to all Standards cited in the Regulatory References section of this document.
   3. Contractor liaison shall have a current, up-to-date manufacturer Certified Technician certificate in both copper and fiber. Copies of the copper and fiber certificates of the manufacturer liaison shall be submitted with the bid.
   4. Contractor agrees all components comprising active links shall be of the same copper Category (6A) or fiber OS/OM designation as the system being installed. Contractor shall under no circumstances mix different Categories or OS/OM classes of cable or termination devices (connectors) within the same link or system.
   5. Contractor shall install all racking and support structures according to cited TIA Standards in such fashion as to maintain both Standards and Manufacturer recommendations for uniform support and protection, segregation of different cable types, maintenance of maximum pulling tensions, minimum bend radius, approved termination methods as well as adhering to industry accepted practices of good workmanship.
   6. Contractor is responsible for understanding and submitting to manufacturer all documents required prior to project start to apply for this warranty. These include but are not limited to the project information form and SCS warranty agreement.
   7. Contractor is responsible for understanding and submitting to manufacturer all documents required at project end. These include completed warranty forms, passing test reports and drawings of floor plans showing locations of links tested.
   8. Test results shall be delivered in the tester native format (not Excel) and represent the full test report. Summaries shall not be accepted. Contact manufacturer for a current list of approved testers, test leads and latest operating systems.
   9. The Communications Contractor shall correct any problems and malfunctions that are warranty-related issues without additional charge for the entire warranty period. The warranty period shall commence following the acceptance of the project by A/E and written confirmation of Warranty from manufacturer.

1.10 SAFETY

A. General
   1. All cabling work being performed on project property or under contract to shall comply with Rules for safe operations, any state or local safety regulations and meet the requirements of OSHA Safety and Health Standards. The contractor Project Manager shall maintain a copy of Rules for Safe Operations for reference. It is the responsibility of the Communications Contractor to immediately correct any unsafe working practices on the part of contractor personnel. Unsafe working environments or conditions created by contractor personnel shall be reported immediately to the Construction Manager.
   2. Any liability for correction of conditions created by the Contractor's personnel rests with the Contractor.
   3. The Communications Contractor shall be solely and completely responsible for conditions of the job site (as pertaining to the materials and equipment specified), including safety of persons and property during performance of Work.
   4. No act, service, drawing review or construction observance by any employee, representative or engineer may be construed as a review or approval of the adequacy of the Contractor (s) safety measures, in, on, or near the construction site.

1.11 WORKING CONDITIONS

A. Site Access
   1. All cable installations shall be pre-approved by the Construction Manager to ensure that the necessary arrangements have been made for proper access to project sites.
   2. A twenty-four-hour prior notice shall be submitted to the Construction Manager for any work schedule changes.

3. Communications Contractor shall display badges or passes as mandated by project property Security Department Rules and Regulations.

B. Scheduling
1. Coordination of site surveys and the issue of project Contracting Agency owned materials and equipment shall be the responsibility of the Construction Manager. Once said equipment and materials are in the Contractor's possession, it is the contractors to safeguard the material and equipment from damage or theft.
2. Information required by the Contractor to price and complete a defined scope of Work shall be furnished to the Communications Contractor by the A/E Project Manager in a Scope of Work document and at the time of the site survey (if necessary) and shall be maintained by the Communications Contractor until the completion of the job.
3. It is the Contractor's responsibility to begin Work promptly according to the Start Dates and to complete Work by the Proposed Completion Date listed on the Cable Run Request Form.
4. The Contractor shall notify the Construction Manager in writing of any delays; at that time, they shall come up with a mutually agreeable project schedule.
5. The Communications Contractor shall coordinate with the Construction Manager working hours and job site access issues.
6. The Communications Contractor shall coordinate with the Construction Manager to minimize outages to the existing systems.
7. Any service interruption required by the Communications Contractor shall be requested in writing and scheduled with the Construction Manager.
8. The Communications Contractor shall not proceed with the requested service interruption until written approval is granted by the Construction Manager.
9. All problems, and questions relating to a particular job, shall be referred to the Construction Manager and no changes shall be made without his/her written approval.

C. Harmony Clause
1. Contractor shall coordinate and work in harmony with other trades on the project as well as with A/E personnel.

1.12 COORDINATION

A. Coordinate layout and installation of voice and data communication cabling with other Contracting Agency contractors and equipment suppliers.
1. Meet jointly with other contractors, equipment suppliers, and Contracting Agency representatives to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute to other participants.
3. Adjust arrangements and locations of distribution frames, cross-connect and patch panels in equipment rooms and telecommunications rooms to accommodate and optimize arrangement and space requirements of voice and LAN equipment.
4. When indicated on drawings, Contractor shall reuse existing copper and fiber optic backbone cables.
5. Provide weekly progress reports and crew schedules to project representatives by 5:00 PM, Thursday (or agreed upon day) of each project work week.

1.13 ACTION SUBMITTALS

A. Product Data: For each product indicated.
1. Submit all product data in accordance with general requirements of the construction documents.
2. Submit product cut sheets and a detailed list of components a minimum of two (2) weeks prior to commencement of Division-27 Work for A/E review and action.
3. Contractor shall submit product materials in one complete Division 27 package, with subdivisions clearly identified. Products applicable to project drawings and specifications clearly identified under each sub-division.
4. Contractor shall provide product data and installation instructions for all fire stopping materials

5. Alternate and "Or Equal" designated products shall be submitted for review and judgment to the A/E prior to installation. The Contractor proposed alternate products or components shall be verified by two (2) independent sources within the past 6 months. This request shall include the two (2) independent sources, the original Product's specification sheet, the proposed substitute product cut sheet, and a written request to review the substitute product.
6. Any request of an alternate or substitution shall be submitted to the A/E for action no later than fourteen (14) calendar days after release of the original telecommunications bid documents.

1.14 INFORMATION & COMMUNICATION TECHNOLOGY (ICT) COMPONENTS

A. The Contract Documents generally outline industry standard components to be installed as part of the project ICT installation requirements. Such identification is intended to be general in nature rather than exhaustive. All stated quantities are subject to validation by ICT contractor. ICT Contractor is reminded that differences between estimated quantities and those reasonably derived based from the Contract Documents (as well as through bid conferences, job walks, addendums, and other distribution of information) shall be the responsibility of the ICT contractor. There shall be no additional cost incurred by Kitsap project for not complying with the specifications and requirements of the Contract Documents.

B. Any variance from those components identified on the drawings and/or below shall be submitted to Kitsap project representatives for approval prior to ordering and installation; the risk for all costs incurred by the ICT Contractor for materials ordered prior to such written approval shall be borne entirely by the ICT contractor. Nonetheless, it is imperative that the ICT Contractor determine the availability of necessary materials and propose equivalent substitutes as necessary to meet all installation milestones. Delays in ICT installations due to lack of product availability are unacceptable. As catalog numbers change frequently, the ICT Contractor shall verify all part numbers prior to ordering materials. Clarifications shall be issued in response to written Requests for Information (RFI).

C. Fire Stop and firestopping requirements for the project include:
   1. All conduits leaving the entrance room for other portions of the building shall be firestopped after the installation of cable.
   2. The Contractor shall fire stop around the tray and, after installation of the cables, within the tray using removable pillow-style products following manufacturers' guidelines. Sound deadening material shall be provided and installed after installation of cable.
   3. Strict adherence to the CEC/NEC NFPA 101 is required for any raceway penetrations of fire-rated walls. See section 07840 for UL system numbers and to construction drawings for details.
   4. All riser conduits shall be sealed using a UL classified fire stop. The Contractor shall provide a copy of the fire seal manufacturer's installation instructions and rating information prior to inspection of the installed materials.
   5. Integrally Fire Stopped Sleeves
      a. Integrally Fire Stopped Sleeves shall be used for Telecommunications cabling in locations where the cabling pathway penetrates a fire barrier. The IFSS shall replace the use of conduit used in conjunction with other fire stopping methods.
      b. All manufacture instructions and requirements shall be followed for the installation of the IFSS.
      c. Documentation shall include picture of completed assemble with time/date stamp.

D. All new fiber optic cabling shall be indoor/outdoor-Plenum rated. Unrated cable (such as filled ASP) shall not be installed within the structure except when placed within IMT, PVC or RGS conduit.

E. Throughout this specification, Corning, Superior Essex, Chatsworth Products, Inc. and other manufacturers are cited. These citations are for the purpose of establishing quality, performance and warranty certification criteria.

1.15 DELIVERY AND STORAGE

A. ICT Contractor shall provide a materials schedule prior to the start date of cable installation. Material schedule shall specify all material quantities and their delivery date for this project.

B. ICT Contractor shall provide protection from weather, moisture, dirt, dust and other contaminants for telecommunications cabling and pathway equipment placed in storage.

1.16 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:
   1. Submit all shop drawings in accordance with the general requirements of the construction documents.
   2. Submit shop drawings a minimum of two (2) weeks prior to commencement of Division-27 Work for A/E review and action.
   3. Shop drawings shall include evidence of grounding and bonding components are coordinated with field conditions and the Work of other trades.
   4. This submittal may have a written component and a visual, drawn component for review and action by the A/E prior to installation.

B. Certificates:
   1. Submit management and installation team reference documentation verifying:
      a. The project manager is a RCDD in good standing with BICSI and is qualified to manage the scope of Work described in the contract documents and has five (5) years of experience managing similar projects in size and scope. The documentation shall include the RCDD registration number.
      b. The field supervisor is a BICSI trained technician that is qualified to perform and oversee the Work described in the contract documents.

C. Qualification Statements:
   1. The Contractor shall submit documentation that within the past 12 months, a minimum of 75% of all installation personnel have been trained or certified by the manufacturer of the products they are installing.

1.17 CLOSEOUT SUBMITTALS

A. As-Built Drawings:
   1. Submit all as-built drawings in accordance with the general requirements of the construction documents.
      a. The drawing notes shall define field conditions experienced not defined in sheet notes.
      b. The drawings shall identify all fire stop locations and digital picture shall accompany as-built package.
   2. Submit as-built drawings a minimum of two (2) weeks after completion of all Division- 27 work for A/E and Contracting Agency reference.
   3. Communication contractor to print, frame and mount approved as-built drawings in MPOE. Coordinate location with A/E.

1.18 QUALITY ASSURANCE

A. Qualifications – Manufacturer
   1. Component manufactures shall be ISO 9001:2000 and offer products that are RoHS compliant.
   2. Installers shall have manufacturer certificate of completion for the fire stop solution being proposed.

B. Qualifications – Installer:
   1. At a minimum, seventy-five percent (75%) of the onsite Contractor provided field technicians shall be factory certified within 12 months by the manufacturer of the selected telecommunications system components being installed. Proof of certification shall be available on site for review at all times for each field technician.

C. Workmanlike Manner
   1. Installers shall address their job functions for this scope of work from the guidance provided by ANSI/NECA-1-2010
   2. Cable - Hangers, Saddles, Supports, J-Hooks shall be routed inline and parallel to building lines.
      a. All cable routing shall maintain an "Above" approach to cabling when crossing any obstruction – Cable Hangers shall be installed to support the cable bundle above and away for physical damage or electrical interference from accidental contact with the UTP cabling system.
      b. Cable hangers shall be installed on a minimum 3/8" threaded rod and installed at a uniformed height above finished floor where ever possible
      c. Maintain a minimum 6" clearance above the finished ceiling
      d. Cable Hanger routing shall be identified on as-built conditions and record drawings
   3. Cable - Hangers, Saddles, Supports, J-Hooks shall be attached per manufacturer's installation requirements and reviewed and confirmed with SEOR prior to rough-in
   4. Cable hangers shall be required to maintain the maximum required cable bundle size for the different rating of PoE (power rating) as listed on the cable jacket
   5. Cable hangers are field defined routing; therefore, all non-rated, fire-fated, acoustical-rated sleeves shall be responsible for configuration, furnish, install, and document.
   6. This requirement includes manufacturer training for proper fire stop installation of technicians performing these installations

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 EXAMINATION

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section.

B. Methodology for fire stop requirements that Contractor shall comply with, include:
   1. In any area in which a fire rated wall, partition, floor, or ceiling is penetrated, the Contractor shall be responsible for creating the pathway and sealing around all cables and sleeves with a UL classified fire seal sufficient to return the structure to its original rating. Creation of such openings as are necessary for cable passage between locations as shown on the drawings shall be the responsibility of the Contractor. Any opening in a rated structure created by the Contractor that is larger than one inch in diameter shall be equipped with a metal sleeve secured and fire-stopped in place.
   2. Comply with requirements in Section 07 84 00 " Firestopping
   3. Comply with TIA-569-B, Annex A, "Firestopping."
   4. Comply with BICSI TDMM, "Firestopping Systems" Article.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 "Joint Sealants."
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall, so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 4 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
   2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

3.02 RE-INSTALLATION

A. No additional burden to the Contracting Agency regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components. Scheduling for re-installation work shall be coordinated, in writing, with the Contracting Agency prior to beginning any re- installation work

3.03 CLOSEOUT ACTIVITIES

A. Contractor shall provide testing results and as-built conditions in the documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the Contracting Agency and A/E team.

B. Contractor to submit all as-built drawings and any test documentation required prior to acceptance by the Contracting Agency

END OF SECTION 27 05 00

This page intentionally left blank

SECTION 27 05 26

GROUNDING BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specifications for grounding and bonding components utilized to provide proper grounding and bonding for telecommunications cabinets, racks, cable tray, ladder tray, cable and equipment.

B. Grounding and bonding components with design criteria.

1.02 RELATED REQUIREMENTS

A. Section 27 05 00 and all divisions of the specification and general provisions of the Construction Documents.

B. Architectural, mechanical, electrical, and all technology drawings.

C. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

1.03 CLOSEOUT SUBMITTALS

A. As-Built Drawings
   1. Submit all as-built drawings in accordance with the general requirements of the construction documents.
   2. Submit as-built drawings a minimum of two (2) weeks after completion of all Division- 27 work for A/E and Contracting Agency reference:

1.04 QUALITY ASSURANCE

A. Qualifications – Manufacturer
   1. Component manufactures shall be ISO 9001:2000 and offer products that are RoHS compliant.

B. Qualifications – Installer:
   1. At a minimum, seventy-five percent (75%) of the onsite sub-contractor provided field technicians shall be factory certified within 12 months by the manufacturer of the selected telecommunications system components being installed. Proof of certification shall be available on site for review at all times for each field technician.

PART 2 PRODUCTS

1. 2.1 GROUNDING AND BONDING

B. Basis-of-Design Product: Subject to compliance with requirements, provide manufacturer or comparable product by one of the following:
   1. CPI.
   2. B-Line.
   3. Circa.
   4. Or Equal.

C. Product Options:
   1. The indicated manufacturers shall be the basis of the design and each component selected shall address the infrastructure requirement.

D. Description:
   1. Sub-contractor is responsible for bonding to ground all newly placed equipment and installed racks or cabinets per the TIA 607-B Standard.
   2. EXECUTION

2.02 EXAMINATION

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section.

2.03 INSTALLATION

A. Process:

1. All newly installed racks and cabinets shall have installed a vertical busbar mounted along one equipment rail to serve as a clean, low-resistance bonding place for any equipment not equipped with a designated grounding pad.
2. Smaller equipment without an integrated grounding pad shall be bonded to the vertical busbar using a thread-forming grounding screw that is anodized green and includes serrations under the head to cut through oxidation or paint on the equipment flange.
3. Larger equipment (chassis switches) with a designated grounding terminal shall be bonded to the vertical busbar with and EBC (equipment bonding conductor) kit built to that purpose.
4. All grounding wire shall be a minimum #6 AWG stranded annealed ground wire, PVC sheathed with nylon. Meets UL83 for THHN or THWN and UL1063.
5. All OSP cabling terminated with-in new campus MDF shall be terminated to a Building Entrance Terminal with gas fuses.
6. Sub-contractor shall take care to clean (wire brush, scotchbrite pads) any metallic surface to be bonded down to bare metal and apply a film of anti-oxidation paste to the surfaces prior to effecting the bond.
7. All bonding lugs on racks and busbars shall be of two-hole irreversible compression type. Mechanical lugs and single-hole lugs will not be accepted and shall be removed and replaced at Sub-contractor's expense.
8. Every rack or cabinet shall have an individual bonding conductor into the grounding network. Serially connecting (daisy-chaining) of racks is expressly forbidden and will not be accepted.
9. Rack Bonding Conductors (RBC) may tap into an overhead or underfloor aisle ground, or may run to the wall-mounted grounding busbar in smaller Telecommunications rooms containing 5 racks or less.
10. Armored cables shall be properly bonded to the earthing system with a kit built to that purpose.
11. All metallic conduit stub-ups shall be grounded, and where multiple stub-ups are made within an equipment enclosure, they shall be equipped with grounding bushings and bonded together and to the enclosure and the enclosure ground bus.
12. Each metallic raceway, pipe, duct and other metal object entering the buildings shall be bonded together. The Sub-contractor shall use #6 AWG green insulated copper conductors.
13. Each identified telecommunications space within a building shall have a common signal reference ground. The signal reference ground shall conform to the following:
    a. Within the building, all communication spaces shall be separately bonded to each other and connected to the primary building ground in accordance with the provisions of EIA/TIA 607. The communication ground shall not ground any other equipment or be connected to any potential high voltage source. All racks, frames, drain wires, and all installed communication equipment shall only be grounded to this common reference ground with a minimum size #6 AWG green insulated copper wire.
    b. The Sub-contractor shall provide, as a minimum, a continuous #3/0 AWG copper electrical conductor connected to a 1/4" x 4" x 12" telecommunications grounding bus bar (TGB) 6" AFF on the plywood backboard of each IDF (or telecommunication space) to terminate chassis and other equipment grounds.
    c. The ground wires from each individual IDF shall be routed directly to the Building Distribution Frame (BDF), terminated and bonded together via a telecommunications main grounding bus bar (TMGB) of minimum 1/4" x 4" x 20" dimensions. This point of single reference for all closets in a building shall in turn be grounded with a minimum #3/0 AWG ground conductor to the main building ground. If a main building ground is unavailable, the ground wire from the BDF shall be grounded to the nearest electrical panel ground bus bar. The building ground for signal reference shall be the building service entrance ground.

14. Ground Bus Bar Identification.
    a. The master ground bar shall be labeled as such.
    b. Each subsidiary ground bar shall be labeled as such and have a unique identifier.
    c. All ground bars shall have a warning label that states, “If this connector or cable is loose or shall be removed, please call the Telecommunications Manager.” All ground bars will be connected to the building ground with continuous “3/0” AWG wire.
    d. Each ground cable shall be labeled with a unique identifier.

2.04 RE-INSTALLATION

A. No additional burden to the Contracting Agency regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components. Scheduling for re-installation work shall be coordinated, in writing, with the Contracting Agency prior to beginning any re- installation work

2.05 CLOSEOUT ACTIVITIES

A. Sub-contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the Contracting Agency and A/E team.

B. Sub-contractor to submit all as-built drawings and any test documentation required prior to acceptance by the Contracting Agency.

END OF SECTION 27 05 26

This page intentionally left blank

SECTION 27 05 29

HANGER AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provides specifications for non-continuous cable support components utilized to provide pathways support to telecommunications cables traveling outside cable trays, conduits, or other continuous cable supports.

B. Non-continuous cable supports.

1.02 RELATED DOCUMENTS

A. Section 27 05 00 and all divisions of the specification and general provisions of the Construction Documents.

B. Architectural, mechanical, electrical, and all technology drawings.

C. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

1. Anywhere cabling Standards conflict with electrical or safety Codes, Sub-contractor shall defer to NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.
2. Knowledge and execution of applicable codes is the sole responsibility of the Sub-contractor.
3. Any code violations committed at the time of installation shall be remedied at the Sub-contractor's expense.

1.03 QUALITY ASSURANCE

A. Qualifications – Manufacturer

1. Component manufactures shall be ISO 9001:2000 and offer products that are RoHS compliant.

B. Qualifications – Installer:

1. At a minimum, seventy-five percent (75%) of the onsite sub-contractor provided field technicians shall be factory certified within 12 months by the manufacturer of the selected telecommunications system components being installed. Proof of certification shall be available on site for review at all times for each field technician.

1.04 WARRANTY

A. Warranty:

1. Sub-contractor shall provide a 25 year System Warranty on all copper and fiber permanent cabling links.
2. This is a system performance warranty guaranteeing for 25 years from acceptance that the installed system shall support all data link protocols for which that copper Category or fiber OM/OS designation is engineered to support according to IEEE and TIA standards.
3. The System Warranty may be invoked only if the cabling channel links are comprised of approved cable infrastructure connectivity and approved cable. Patch cords must be manufactured by same approved cable and/or connectivity system.
4. Upon acceptance of Warranty, manufacturer will mail a notification letter to the installer and a notification letter and warranty certificate to A/E.

PART 2 PRODUCTS

2.01 NON-CONTINUOUS CABLE SUPPORTS

A. Basis-of-Design Product: Subject to compliance with requirements:

1. Erico – Caddy CableCat Support System
2. Copper/BLine – Cable Hook System
3. CEAS Attachments – Stiffy Series
4. Panduit – Jmod Cable Support System

5. Or Equal

B. Product Options:
   1. The indicated manufacturers shall be the basis of the design and each component selected shall address the particular infrastructure requirement.
      a. Stiffy Series with metal cradles. Plastic cable saddles not permitted.
      b. Four inch (0'4"), two inch (0'2") J-Hook Supports

C. Description:
   1. Non-continuous cable supports shall be available in multiple sizes, styles and materials. Rigid supports shall be equipped with flared edges and pre-configured bend radius controls.
   2. Provide drop wire supports and threaded rod assemblies in areas where structural mounting surfaces are non-functional or inaccessible.
   3. Support assemblies shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance UTP and optical fiber cables.
   4. Non-continuous cable supports sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be reusable.
   5. Select approved non-continuous cable supports suitable for specific installation environments and/or air handling (plenum) spaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section.

3.02 INSTALLATION

A. Process:
   1. Follow manufacturer's instructions and recommended industry standards and guidelines.
   2. The installed non-continuous support system must be an independent support structure for the voice/data communication system.
   3. Draping cables over other structures in the ceiling is unacceptable. Water pipes, ceiling grid, sprinkler system, electrical supports, air ducts or any other in-ceiling structure may not be used for cable support.
   4. Sub-contractor installed supports shall be used to supplement the main cable support system when any cabling leaves the main support system or is unsupported for more than three and one half feet (3'-5'-0") feet.
   5. Non-continuous supports shall be installed with rod stock or threaded rod secured to the slab above to support the telecommunications cable infrastructure parallel to the slab throughout the cable plant, unless site conditions dictate a non-parallel installation.
   6. Cable must be routed to follow existing corridors and parallel or 90 degree angles from all walls and the cable tray whenever possible.
   7. Communication EMT conduit sleeves shall receive conduit waterfall to control bend radius of the communication cable to a minimum of a 4" radius.
   8. All pathways shall avoid electromagnetic interference (EMI). Cable that is distributed in partially-enclosed metallic pathways shall be routed with the following minimum clearances:
      a. Four (4) feet from motors or transformers.
      b. One (1) foot from conduit and cables used for electrical power and distribution.
      c. Five (5) inches from fluorescent lighting.

3.03 RE-INSTALLATION

A. No additional burden to the Contracting Agency regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components. Scheduling for re-installation work shall be coordinated, in writing, with the Contracting Agency prior to beginning any re- installation work

3.04 CLOSEOUT ACTIVITIES

A. Sub-contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the Contracting Agency and A/E team.

B. Sub-contractor to submit all as-built drawings and any test documentation required prior to acceptance by the Contracting Agency

END OF SECTION 27 05 29

This page intentionally left blank

SECTION 27 05 33

CONDUITS AND BOXES FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provides specifications for conduit pathways, back boxes and pull box enclosures utilized for the distribution and housing of telecommunications cabling and components:

B. Telecom EMT conduit and boxes

1.02 RELATED DOCUMENTS

A. All divisions of the specification and general provisions of the Construction Documents.

B. Architectural, mechanical, electrical, and all technology drawings.

C. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

PART 2 PRODUCTS

2.01 CONDUIT AND BACKBOXES

A. EMT conduit
   1. Wheatland Tube.
   2. Appleton.
   3. Crouse-Hinds.
   4. Or equal.

B. PVC conduit
   1. JM Eagle.
   2. Electro Flex.
   3. Or equal.

C. Pull boxes
   1. Hoffman Engineering Co,
   2. Or equal.

D. Back Boxes
   1. Thomas & Betts.
   2. Hubbell Raco.

2.02 TELECOMMUNICATIONS CONDUIT AND BACKBOXES

A. Electrical Metallic Galvanized Tubing and Fittings with natural finish for all conduits not exposed: ANSI C80.3 with compression-type fittings.

B. Communication EMT conduit sleeves shall receive conduit waterfall to control bend radius of the communication cable to a minimum of a 4” radius.

C. Indoor Pull boxes: Galvanized steel, screw cover pull box. Grey polyester powder coat finish inside and out. NEMA Type 1. Pull boxes to be sized per NEC code to accommodate the number of EMT conduits as shown on Telecom drawings with adequate clearances, access and cable management space.

D. Supporting devices: U channel trapeze assemblies, 1/2” Threaded rods, clamps, conduit straps, C-clamps and retainers.

E. Fasteners: 3/8” Carbon steel expansion anchors with 2 ½” embed into concrete slab for pull box U-channel support attachment to concrete slab. The anchors must be tested and approved under dual load conditions.

F. U-channel systems: 16 gauge steel channels. Provide fittings and accessories that match with the U-channel of the same manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

Conduit Trade Size (in.)	Pull box Width (in.)	Pull box Length (in.)	Pull box Depth (in.)	Pull box Width Increase for Additional Conduit (in.)
1	4	16	3	2
1 1/4	6	20	3	3
1 1/2	8	27	4	4
2	8	36	4	5
2 1/2	10	42	5	6
3	12	48	5	6
3 1/2	12	54	6	6
4	15	60	8	8

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section.

3.02 INSTALLATION

A. Pull boxes:
   1. Install Pull boxes in easily accessible locations.
   2. Install Horizontal cabling boxes immediately above suspended ceilings.
   3. A pull box should not be used in lieu of a bend.
   4. Conduits that enter the pull box from opposite ends with each other should be aligned.
   5. For direct access to a box located above inaccessible ceilings provide a suitable, marked, hinged access panel (or equivalent) in the ceiling. This access panel can also serve as the cover for the box.
   6. Install conduit radius waterfall for all EMT conduit sleeves entering telecommunication room or through main pathway fire rated walls, quantity as shown on drawings.
   7. Pull box sizing table:

B. Back Boxes
   1. Provide 4-11/16” H X 4-11/16” W X 2-1/8” D outlet back boxes at all telecom outlet locations shown on drawings. Provide (1) 1-1/4” conduit from back box to telecom room or pull box except as otherwise noted. All connectors and couplings shall be zinc-plated steel set screw type. Die cast zinc fittings are not to be used. Provide bushing on ends of all conduits. Provide pull string in all conduits.
   2. Provide single gang plaster ring on all communications outlet back boxes, unless indicated otherwise.
   3. Provide bonding to cable tray pathways.

C. Conduit support and bracing:
   1. Coordinate layout and installation of conduits and pull boxes with other trade conditions to ensure adequate clearances, access and cable management.
   2. Install and provide support for EMT conduits and pull boxes in accordance with the latest edition of the NEC code, as well as all state and local codes and requirements. Coordinate installation and location with existing conditions. Notify and get the Contracting Agency’s Representative approval before installing conduits and pull boxes where the location need to deviate from the contract documents.
   3. Install conduits above ceilings at height to provide access to pull. Install conduits and pull boxes level and square and at proper elevations. Ensure adequate clearances, access and cable management.
   4. Use fittings and support devices compatible with conduits and pull boxes and suitable for use and location. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four.

5. Install individual and multiple trapeze hangers and riser clamps as necessary to support the conduits. Provide U-bolts, clamp attachments and other necessary hardware for hanger assemblies and for securing hanger rods and conduits. Space supports for conduits on maximum 10-foot centers.
6. Provide and install expansion or deflection fittings for conduits runs at all instances at seismic or expansion joints to allow for movement in any direction.

D. Conduit routing, bends and radius guidelines:
1. If the conduit has an internal diameter of 2 inches or less the bend radius must be at least 6 times the internal conduit diameter.
2. If the conduit has an internal diameter of more than 2 inches the bend radius must be at least 10 times the internal conduit diameter.
3. Conduit bends should be smooth, even, and free of kinks or other discontinuities that may have detrimental effects on pulling tension or cable integrity during or after installation.
4. If a conduit run requires more than two 90-degree bends then provide a pull box between sections with two bends or less.
5. If a conduit run requires a reverse bend (between 100 degrees and 180 degrees) then insert a pull point or pull box at each bend having an angle from 100 degrees to 180 degrees.
6. Consider an offset as equivalent to a 90-degree bend.
7. A pullbox shall not be used as a 90-degree bend.
8. Communication EMT conduit sleeves shall receive conduit waterfall to control bend radius of the communication cable to a minimum of a 4” radius.
9. Achieve the best direct route with no bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes.
10. Contain no continuous sections longer than 100 ft.
11. For runs that total more than 100 ft. in length, pull points or pull boxes should be inserted so that no segment between points/boxes exceeds the 100 ft. limit.
12. Withstand the environment to which they will be exposed.
13. Conduits should not be routed through areas in which flammable material may be stored or over or adjacent to boilers, incinerators, hot-water lines and steam lines.
14. Keep conduits at least 6’ away from parallel runs of steam, hot water pipes or mechanical ductwork.

E. Conduit Terminations
1. Join conduits with fittings designed and approved for the purpose. Make the joints tight without protruding lips that can snag cable pulling inside the conduits.
2. Where conduits are terminated with locknuts and bushings align the conduit to enter squarely and install the locknuts with dished part against the box. Use two locknuts, one inside and one outside the box.
3. Ream all conduit ends and fit them with an insulated bushing to eliminate sharp edges that can damage cables during installation or service.
4. Conduits that enter a telecom room should terminate near the corners to allow for proper cable racking.
5. Terminate conduits that protrude through the structural floor 3 inches above the surface.
6. Maintain the integrity of all fire stop barriers for all floor or wall penetrations.

F. Provide grounding and bonding for conduits and pull boxes as indicated by NEC code and instructed by manufacturer.

G. Conduits shall be clearly labeled at both ends designating the opposite locations(s) served. The numbering scheme shall be room number plus a suffix to guarantee uniqueness, e.g., 143-1. Labeling must be machine generated.

H. Conduit Protection:
1. Remove burrs, dirt and construction debris from conduits and pull boxes.
2. Conduits should be left capped for protection.
3. Provide final protection and maintain conditions in a manner acceptable to the Contracting Agency’s Representative to ensure that coatings, finishes and pull boxes are without

damage or deterioration at completion. Repair damage to galvanized finishes with zinc-rich paint recommended by the manufacturer.

3.03 ACCEPTANCE

A. All specified conduits and pull boxes indicated on the drawings and specifications shall be complete.

B. Specified shop drawings and product submittals shall have been submitted for review and all review comments and deficiencies shall have been resolved. Final shop drawings and product submittals shall have been submitted, reviewed and found to meet the requirements of the specifications.

C. Issues and deficiencies identified in field reports and punch lists shall have been resolved. Final as-built drawings shall have been submitted, reviewed and found to meet the requirements of the specifications.

D. Sub-contractor shall provide written notice of final completion of the telecom infrastructure. Upon receipt, the Contracting Agency will review/observe the completed installation. Once the Contracting Agency is satisfied that all work is in accordance with the Contract Documents, the Sub-contractor will be notified in writing.

3.04 RE-INSTALLATION

A. No additional burden to the Contracting Agency regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components. Scheduling for re-installation work shall be coordinated, in writing, with the Contracting Agency prior to beginning any re- installation work

3.05 CLOSEOUT ACTIVITIES

A. Sub-contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the Contracting Agency and A/E team.

B. Sub-contractor to submit all as-built drawings and any test documentation required prior to acceptance by the Contracting Agency

END OF SECTION 27 05 33

SECTION 27 05 36

CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Section 27 05 00 and all divisions of the specification and general provisions of the Construction Documents.

B. Architectural, mechanical, electrical, and all technology drawings.

C. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

1.02 SUMMARY

A. Section Includes:
   1. Ladder cable trays.
   2. Wire-basket cable trays.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of cable tray.
   1. Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.
   1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings. Drawings to match same scale as approved design or construction drawing set.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
   2. Vertical and horizontal offsets and transitions.
   3. Clearances for access above and to side of cable trays.
   4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.

B. Seismic Qualification Certificates: For cable trays, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
   2. Component Importance Factor: 1.5.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Cable Trays and Accessories: Identified as defined in 2016 CEC Article 392 and marked for intended location, application, and bonding per Article 800.100/A/1-6.
   1. Source Limitations: Obtain cable trays and components from single manufacturer.

B. Sizes and Configurations: See drawings for specific requirements for types, materials, sizes, and configurations.

C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
   1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
   2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
   3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.03 LADDER CABLE TRAYS (LADDER RACKING)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Cooper B-Line, Inc.
   2. Chatsworth Products Inc.
   3. Hoffman Pentair

B. Description:
   1. Configuration: Two 1-1/2'' x 3/8'' 16-gauge tubular steel side rails with transverse rungs welded to side rails.
   2. Rung Spacing: 9 inches O.C.
   3. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
   4. Minimum Cable-Bearing Surface for Rungs: 1-inch width with radius edges.
   5. No portion of the rungs shall protrude below the bottom plane of side rails.
   6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1, Section 5.4.
   7. Straight Section Lengths: 9 feet 11.5 inches except where shorter lengths are required to facilitate tray assembly.
   8. Width: 12 inches unless otherwise indicated on Drawings.
   9. Fitting Minimum Radius: 12 inches.
   10. Splicing Assemblies: Bolted type using serrated flange locknuts.
   11. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.04 WIRE-BASKET CABLE TRAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Cablofil/Legrand.
   2. Cooper B-Line, Inc.
   3. Snaketray.
   4. Chatsworth Products Inc.

B. Description:
   1. Configuration: Wires are formed into a standard 2-by-4-inch wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.

2. Materials: High-strength-steel longitudinal wires with no bends.
3. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.
4. Sizes:
   a. Straight sections shall be furnished in standard 10 feet lengths.
   b. Wire-Basket Depth: 2-inch usable loading depth by 4 inches to 24 inches wide.
   c. Wire-Basket Depth: 4-inch usable loading depth by 4 inches to 24 inches wide.
   d. Wire-Basket Depth: 6-inch usable loading depth by 8 inches to 24 inches wide.
5. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
6. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
7. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.

2.05 MATERIALS AND FINISHES

A. Steel:
1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1008/A 1008M, Grade 33, Type 2.
2. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
3. Finish: Mill galvanized before fabrication.
   a. Standard: Comply with ASTM A 653SS/A 653M, G90.
   b. Hardware: Chromium-zinc plated, ASTM F 1136.
4. Finish: Electrogalvanized before fabrication.
   a. Standard: Comply with ASTM B 633SS.
   b. Hardware: Galvanized, ASTM B 633SS.
5. Finish: Hot-dip galvanized after fabrication.
   a. Standard: Comply with ASTM A 123/A 123M, Class B2/ASTM A1008, Grade 33, Type 2.
   b. Hardware: Chromium-zinc plated, ASTM F 1136.
6. Finish: Powder-coat enamel paint.
   a. Powder-Coat Enamel: Cable tray manufacturer's recommended primer and corrosion-inhibiting treatment, with factory-applied powder-coat paint.
   b. Epoxy-Resin Prime Coat: Cold-curing epoxy primer, MPI# 101.
   c. Epoxy-Resin Topcoat: Epoxy, cold-cured, gloss, MPI# 77.
   d. Hardware: Chromium-zinc plated, ASTM F 1136.
7. Finish: Factory-standard primer, ready for field painting, with chromium-zinc-plated hardware according to ASTM F 1136.
8. Finish: Black oxide finish for support accessories and miscellaneous hardware according to ASTM D 769.

B. Aluminum:
1. Materials: Alloy 6063-T6 according to ANSI H 35.1/H 35.1M for extruded components and Alloy 6061-T6 according to ANSI H 35.1/H 35.1M for fabricated parts.
2. Hardware: Chromium-zinc-plated steel, ASTM F 1136.

2.06 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Barrier Strips: Same materials and finishes as for cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.07 WARNING SIGNS

A. Lettering: 1-1/2-inch high, black letters on yellow background with legend "Warning Not to Be Used as Walkway, Ladder, or Support for Ladders or Personnel."

B. Comply with requirements for fasteners in Section 26 05 53 "Identification for Electrical Systems."

2.08 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA VE 1.

PART 3 EXECUTION

3.01 CABLE TRAY INSTALLATION

A. Install cable trays according to NEMA VE 2.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

D. Remove burrs and sharp edges from cable trays.

E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.

F. Fasten cable tray supports to building structure and install seismic restraints.

G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems."Comply with seismic-restraint details according to Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."

H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

J. Support bus assembly to prevent twisting from eccentric loading.

K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.

L. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

M. Support wire-basket cable trays with center support hangers, trapeze hangers, or wall brackets as noted on construction drawings.

N. Support center support hangers and trapeze hangers for wire-basket trays with 3/8-inch- diameter rods.

O. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

P. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.

Q. Make changes in direction and elevation using manufacturer's recommended fittings.

R. Make cable tray connections using manufacturer's recommended fittings.

S. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

T. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

U. Install cable trays with enough workspace to permit access for installing cables.

V. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.

W. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.

X. Clamp covers on cable trays installed outdoors with heavy-duty clamps.

Y. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.02 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in ANSI/NECA/BICSI-607, ITSM-2017, and Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Cable trays with control conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

E. Bond cable trays to power source for cables contained within with bonding conductors sized according to ANSI/NECA/BICSI-607, ITSM-2017, and Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.03 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Fasten cables on vertical runs to cable trays every 18 inches.

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.

E. Tie MI cables down every 36 inches where required to provide a 2-hour fire rating and every 72 inches elsewhere.

F. In existing construction, remove inactive or dead cables from cable trays.

3.04 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.05 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.

2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.06 PROTECTION

A. Protect installed cable trays and cables.
1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 27 05 36

SECTION 27 05 43

UNDERGROUND DUCTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Publications and Standards.

B. Work Sequencing and Coordination.

C. Telecommunications Submittals.

D. Quality Assurance.

1.02 PUBLICATIONS AND STANDARDS

A. National Electrical Code (NEC) (ANSI/NFPA 70):
   1. Chapter 8: “Communications Systems”
   2. Article 250: “Grounding”

B. Telecommunications Industry Association TIA 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications

C. Federal Communications Commission (FCC) Part 15 and Part 68

D. Rural Utilities Services (RUS), formally REA

E. Lightning Protection Code - ANSI/NFPA 780-2017

F. American Society for Testing Materials (ASTM) Publications

G. National Electrical Manufacturer’s Association (NEMA) Publications

H. State of California Administrative Code, Title 24, Part 3, CCR, 1994 California Electrical Code

I. State of California Public Utilities Commission (Cal. P.U.C.) Publication: G.O. 92, 95, & 128 Rules for Construction of Underground Electrical and Communications Systems

J. Underwriters Laboratories Inc. (U.L.) Publications
   1. 6-1981 (R86) Rigid Metallic Conduit
   2. 514B-1982 Fittings for Conduit and outlet Boxes
   3. 651-1981 Schedule 40 and 80 Rigid PVC Conduit
   4. UL 467 “Grounding and Bonding Equipment”
   5. UL 497, 497A, and 497B “Communications Circuit Protectors”

1.03 RELATED SECTIONS

A. Contract Terms and Conditions

B. Division 26 Related Electrical Underground Section(s)

C. Division 26 Related Bonding and Earthing Section(s)

1.04 SUBMITTALS

A. Submittals shall be made as defined in Section 27 05 00.

1.05 QUALITY ASSURANCE

A. For products or workmanship specified by association, trade, Federal, or State Standards, the Contractor shall comply with the requirements of the standard. When more rigid requirements are specified or required by applicable (City) codes, the Contractor shall comply with City codes and local AHJ requirements.

B. The Contractor shall conform to reference standard by date of issue current on final design documents.

PART 2 PRODUCTS

2.01 COMMUNICATIONS UTILITY VAULTS

A. All telecommunications vaults to be placed shall be specifically designed for telecommunications applications, with no exceptions.

B. Materials
   1. The Contractor shall provide pre-cast utility vaults meeting ASTM C 478 with 28-day 5500 psi minimum compressive strength concrete and designed for AASHTO H-20 loading per AASHTO HB 14. The dimensions for each utility vault are specified on the construction drawings. Any questions the Contractor has about the size should be discussed with the Contracting Agency and the telecommunications engineer.
   2. Utility vaults shall have tongue-and-grove double sealed joints on mating edges of pre-cast components. The joints shall firmly interlock adjoining components and provide waterproof junctions and adequate shear transfer. Joints shall be sealed with approved watertight joint sealant as prescribed in the manufacturer's installation specifications and conforming to AASHTO M198, Type B. Sealing material shall be installed in strict accordance with manufacturer's printed instructions.
   3. Conduit Entrances
      a. Knockout panels or pre-cast individual conduit openings may be used.
      b. On sides where no conduit is installed, 12-inch high by 12-inch wide (minimum) knockout panels for future raceway installation shall be provided. Knockouts are required on all four sides.
      c. For existing utility vaults, new ducts shall enter the utility vault with factory-formed bell end of the conduit, and a seal around the conduit shall be applied after installation. Existing utility vaults shall be retrofitted with the required racking and grounding and bonding per the TIA Bonding and Grounding Standards.
   4. Covers
      a. The Contractor shall provide solid covers (traffic rated), with a 76.2 cm (30 in.) diameter clear opening. For vaults longer than 12' in length, (2) openings with covers are required.
      b. Heavy-duty type frames and covers made of cast iron 10" high, suitable for H-20 loading, and having machined bearing surfaces shall be used.
      c. The covers shall be of indented type with solid top design.
      d. The upper side of each cover shall have the letters "Communications" cast or burned by welder, in integral letters no less than 2 inches high. Either the covers or the ring of the casting shall be field stamped with utility vault or pull box numbers.

C. Manufacturers
   1. Utility Vault Company (Old Castle)
   2. Jensen Precast
   3. Approved equivalent product

2.02 COMMUNICATIONS PULL BOXES

A. Pre-cast pull boxes shall meet the standards defined in Subsection 2.1.B.(1).

B. Joints and seals shall be provided and installed as defined in Subsection 2.1.B.(2).

C. Conduit entrances shall be provided as defined in Subsection 2.1.B.(3).

D. Pull boxes shall be equipped with cable racking on both long walls suitable to support large copper cables as called for on the design documents.

E. All pull boxes shall be equipped with spring-loaded, traffic-rated, skid proof lids with a locking mechanism, unless otherwise specified in the drawings. All lids shall have the identification marking of "Communications" permanently affixed to the cover. The pull box number identification shall be stamped or welded on the cover per the Contracting Agency's specified numbering plan.

2.03 COMMUNICATIONS UTILITY VAULT/PULL BOX HARDWARE

A. Materials
   1. Pulling irons shall be provided, as required for the size of utility vault/pull box (minimum of 4 per utility vault: 2 placed on each end wall, top and bottom). Pulling irons shall be placed opposite the terminators. All pulling irons shall be constructed of 2.2 cm (7/8 inch) hot-dip galvanized steel.

2. A sump of 30cm (12 in.) in diameter shall be provided in each utility vault, per the manufacturer's specifications.
3. Heavy-weight cable racks with adjustable arms shall be provided for all cables in each utility vault. The racks shall be attached with adjustable inserts set in the concrete walls (bolts or studs embedded in concrete will not be used). Racks and inserts shall be centered on the side walls that are utilized for the racking of splice cases in the utility vault, arranged so that all spare conduit ends are clear for future cable installation. The racks shall have a sufficient number of arms to accommodate cables for each conduit entering or leaving the utility vault.
4. Corner stand-off brackets 15cm to 20cm (6 in. to 8 in. from wall) shall be provided if the utility vault is equipped with center exit conduits. The bracket shall extend from 15cm (6 in.) off floor to 15cm (6 in.) below roof.
5. All utility vault and pull box hardware shall be steel that is hot dip galvanized after fabrication.
6. Each utility vault shall have a detachable galvanized steel ladder that can be removed to facilitate future work in the utility vault. The ladder shall be secured to a top support arm in the utility vault opening or chimney.

B. Manufacturers
1. Hardware: Alhambra Foundry (model No. A-3382 ladder with A-3383 support bar) or Inwesco Products, or an approved equivalent product.
2. Utility vault: Utility Vault, or Associated Concrete Products, or an approved equivalent product.

C. Materials
1. Conduit
a. Schedule 40 PVC - 4 inch inside diameter.
b. Type C telephone conduit - 4 inch inside diameter (if concrete encased).
c. If directional boring: HDPE Conduit, 4" from Carlon or equal.
d. Corrugated flexible orange inner duct, 1-inch ID diameter, will be placed for fiber optic cable protection. A minimum of 4 inner ducts shall be placed in a 4-inch conduit, unless otherwise directed in the drawings.
2. Conduit shall have a factory formed bell on one end for interconnecting segments.
3. Spacers: High impact spacers shall be used in all multi-duct systems, for both solely-owned or joint telecommunications/power construction. They shall conform with NEMA TC-2, TC-6, TC-8, and ASTM F 512 dimensions.
4. All fittings shall be designed specifically for use with the type of conduit placed.
5. All conduits shall be equipped with seal plugs in all utility vaults/pull boxes and expansion rubber seal plugs within all buildings.
6. Manufacturer: CARLON or approved equivalent.

2.04 COMMUNICATIONS ENTRANCE CONDUIT

A. To prevent shear, all conduit entering a building shall transition from PVC to metal from a minimum distance of 24" beyond the exterior of the foundation. These conduits shall slope downward away from the building to reduce the potential of water entering the building.

2.05 DUCT-BANK LOCATING CABLE (DETECTABLE WARNING TAPE)

A. Warning tape shall be a minimum of 3" wide, orange in color, and shall have a nondegradable imprint as follows:
1. "Caution Joint Power and Telecom Cable Buried Below"

B. The tape shall be detectable.

C. Manufacturer:
1. Carlon
2. Approved equivalent product

2.06 PULL ROPE

A. Pull rope shall be new 1/4" polypropylene over polyester rope with a minimum 1700 lb. tensile strength or woven cotton cord with footage markings (mule tape).

B. Manufacturers: Carlon or approved equivalent.

2.07 BONDING/GROUNDING – VAULTS AND PULL BOXES

A. The reinforcing steel in the walls of the utility vault shall be bonded together and brazed to the bronze inserts of each section of the utility vault per the manufacturer's utility vault specifications. Two ground rods at opposite corners shall be furnished and installed in each vault (one rod in vaults smaller than 3' X 5' X 4'). The ground inserts shall be attached to the steel rebar to provide a point of attachment for the ground wires or bonding ribbon. The inserts shall be bronze, flush mounted, and brazed (exothermic weld) to the rebar cage of all the sections of the utility vault (bottom, intermediate, and roof sections).

B. Materials
   1. Bonding Ribbon: Shall be made of annealed solid copper 3/8-inch-wide x 1/16 inch thick, tin plated. Manufacturer: INWESCO Cat.12A55 or approved equivalent.
   2. Bonding Ribbon Clamp: Shall be made of soft lead 1/2-inch-wide by 1/16-inch-thick and shall accept 1/4-inch diameter bolt. Manufacturer: INWESCO Cat. 12A56 or approved equivalent.
   3. Fargo Clamp: Shall be cast from copper, silver plated, furnished with copper bolt. Manufacturer: INWESCO Cat.12A57 or approved equivalent.
   4. Ground Rod: Shall be manufactured of high strength high carbon steel, with electrolytically bonded jacket of copper on surface, and shall meet UL spec. 467 and ANSI C-33.8-1072. Manufacturer: INWESCO Cat.12A60 or approved equivalent.
   5. Ground Inserts: Shall be made of Cast Bronze W/1/4 Copper Rod. Manufacturer: INWESCO Cat.12H69 or approved equivalent.

2.08 RACEWAY TAGS

A. Permanent markers with raceway designations engraved onto the tag shall be provided. Tags relying on adhesives or taped-on markers shall not be used.

2.09 DUCT PLUGS

A. Provide duct plugs capping all empty conduit and at conduit with installed cabling. All ducts and duct plugs must be re-enterable.

PART 3 EXECUTION

3.01 COMMUNICATIONS UTILITY VAULTS AND PULL BOXES

A. General
   1. The Contractor shall obtain all required permits and notifications before commencing any work operations.
   2. All state and local ordinances shall be complied with at all times.
   3. All federal, state, and local safety rules, including OSHA, will be enforced at all times during the duration of the project. It is the responsibility of the Contractor to inspect the job site to ensure compliance.

B. Final location of all communications utility vaults and pull boxes shall be determined by the Contractor and Contracting Agency.

C. All conduits entering a utility vault or pull box shall be placed at right angles to the short walls and shall be sealed to prevent seepage unless otherwise specified on the construction documents.

D. Excavation dimensions shall be verified with the utility vault supplier in advance so as to prevent delays in setting schedule. All utility vaults and pull boxes shall be placed on 12 inches of compacted bedding material.

E. Shoring shall be in accordance to prevailing underground construction codes, i.e., OSHA, G. O. 128, NESC, and all applicable local, state, and federal statutes.

F. All utility vaults shall be equipped with pulling irons and a ladder for access.

G. Finish grade shall be established prior to placing structures.

H. The Contractor and the Contracting Agency shall inspect all utility vaults prior to backfilling.

I. Backfill materials shall have been sifted to provide a sand equivalent of not less than 20, and a sieve size of No.4 Backfill material shall be mechanically compacted to a minimum relative compaction of 90 percent to a level six (6) inches above final grade. The excess material shall be excavated to the final grade upon acceptance of compaction.

J. Existing and/or new communications utility vaults/pull boxes may be placed near the existing power and signal vault system. The Contractor shall either place new or enlarge existing utility vaults/pull boxes and conduits in such a manner as to not disturb existing utilities while maintaining specified clearances from all obstructions. This may require clearing much of the area around the vaults by hand. The final placement and depth shall be determined by the Contractor and Contracting Agency.

K. The Contractor shall locate all existing utilities within 20 feet of the new and/or enlarged utility vault/pull box system. The Contractor and Contracting Agency shall review and approve any revised coordination schematics. Caution shall be used when working in this area.

L. The Contractor shall excavate around existing vaults using caution to identify and preserve all utilities in the area.

3.02 UTILITY VAULT COVERS AND HARDWARE

A. Pull boxes shall be equipped with a non-skid, spring-loaded traffic-capable lid with a locking mechanism.

3.03 DUCT BANKS AND CONDUITS

A. All communications conduit banks shall be encased in slurry (2 bag cement mix, minimum 1800 PSI) with at least 2 inches of concrete at the top and bottom and 2 inches on each side when deemed necessary based on one or more of the following: bending radius, weight bearing, mechanical stress, etc. A horizontal and vertical separation of 2 inches between the ducts shall be maintained by installing high impact spacers with horizontal and vertical locking intervals of ten feet. Concrete shall have ten pounds of red oxide added for color.

B. All communications conduit shall be placed in a uniform manner between vaults. Conduit in position #1 at one utility vault shall maintain its position within the duct run and terminate in the #1 position at the next utility vault. The position of all conduits between utility vaults shall be maintained. All conduits shall enter utility vaults using the lower most precast knockouts.

C. Long radius bends (over 40 feet) shall be used whenever possible to make changes in direction. If it is found to be necessary to place a 90-degree bend in the conduit run, a factory-made sweep of no less than 12’ 6” radius shall be used. No conduit run shall exceed a total of 180 degrees of bend between any two points (such as utility vaults or buildings) considering both vertical and horizontal sweeps. Cold formed trench bends shall have a radius of not less than 40 feet and shall pass mandrel integrity. Bend radius criteria for conduit size 2” or less is 6 times the diameter of the conduit and, for any conduit larger than 2”, 10 times the diameter of the conduit.

D. All bends of less than 20-foot radius shall be encased in concrete when using Type C or Schedule 40 PVC conduits. Encasement shall start from 2 feet before curve to 2 feet past curve. Concrete shall be Type B at 2500 PSI, aggregate of no more than ¼” minus. Conduits shall be spaced at 2 inches minimum using high impact spacers at 2 feet on center.

E. The length and destination of all conduits shall be identified in each utility vault, pull box, and building. Embossed metal tags identifying each conduit shall be placed on end walls.

F. After installation of communications conduit, the Contractor shall prove all conduits by pulling a mandrel with a diameter □ inch smaller than the conduit and 6 inches long through each conduit end-to-end. An inspector designated by the Contractor and the Contracting Agency shall be notified 24 hours before this procedure. Each conduit shall be cleaned with a bristle brush to remove any debris.

G. All utility vault and pull box entrances shall be shear-blocked with standard concrete extending no less than 15 inches from the entry wall. All entering ducts shall be completely encased.

H. Utility marking tape (see 3.5.A) shall be buried 12 inches below the surface directly above the conduit.

I. All conduit structures shall be built with the telecommunications conduits placed above the power conduits unless otherwise called out on the construction drawings and approved by the campus. If this type of construction is required, it shall receive the prior approval of the Contractor, the Contracting Agency, and the Local Exchange Carrier.

J. All entrance conduits shall be securely fastened to the building. The end of the conduit located inside the building shall be sealed with expandable solid plugs to prevent rodents, water, or gases from entering the building.

3.04 ENTRANCE CONDUIT

A. The Contractor and the Contracting Agency shall determine the placement of all entrance conduit. All Applicable standards shall be adhered to, i.e., NEC, BICSI, Western Electric OSP, NESC or G.O. 128.

3.05 LOCATING DUCT BANK CABLE

A. Underground detectable warning tape shall be placed in all trenches at one foot below the final grade after the conduit and encasement is complete. The tape shall indicate the type of cable that will utilize the substructure system, e.g., fiber optic or copper cables. The detectable warning tape shall be installed according to manufacturer's specifications to ensure access to the tape for locating purposes.

3.06 PULL ROPE

A. Pull rope shall be new material that is free of knots, kinks, and abrasions.

B. Pull rope shall be placed as a single continuous length in every new duct section. (See Section 16730, 2.7.)

C. Pull rope shall be secured at each end.

3.07 BONDING/GROUNDING

A. Two ground rods shall be installed in each new manhole and one rod in a new pull box. All non-current-carrying metal parts in the utility vault and any metallic raceway grounding bushing shall be connected to this ground rod with a No. 4/0 bare copper ground conductor and approved ground clamp, as required per NEC.

B. The grounding system shall not rely on plumbing systems.

C. Bonding conductors shall be routed with a minimum number of bends. The bends placed in the conductor should be sweeping.

D. All bonding connections shall utilize listed bolts, crimp pressure connectors, clamps, or lugs. Exothermic welding may be used.

E. Multiple bus bars shall be directly bonded together with a No. 4/0 copper conductor.

F. Backbone cabling shall be bonded at each sheath opening with, minimally, a 6-AWG copper conductor.

END OF SECTION 27 05 43

SECTION 27 05 53

IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provides specifications information for identification of the various components of the telecommunications infrastructure and pathway system.

B. Labeling and identification.

1.02 RELATED DOCUMENTS

A. Section 27 05 00 and all divisions of the specification and general provisions of the Construction Documents.

B. Architectural, mechanical, electrical, and all technology drawings.

C. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

1.03 CLOSEOUT SUBMITTALS

A. As-Built Drawings:
   1. Submit all as-built drawings in accordance with the general requirements of the construction documents.
   2. Submit as-built drawings a minimum of two (2) weeks after completion of all Division- 27 work for A/E and Contracting Agency reference:
   3. Communication sub-contractor to print, frame and mount approved as-built drawings in MPOE. Coordinate location with A/E.

1.04 QUALITY ASSURANCE

A. Qualifications – Manufacturer
   1. Component manufactures shall be ISO 9001:2000 and offer products that are RoHS compliant.

B. Qualifications – Installer:
   1. At a minimum, seventy-five percent (75%) of the onsite sub-contractor provided field technicians shall be factory certified within 12 months by the manufacturer of the selected telecommunications system components being installed. Proof of certification shall be available on site for review at all times for each field technician.

PART 2 PRODUCTS

2.01 IDENTIFICATION LABELS

A. Basis-of-Design Product: Subject to compliance with requirements:
   1. Panduit – Thermal Transfer
   2. Brady Label System
   3. Brother Label System
   4. Or Equal

B. Product Options:
   1. The indicated manufacturers shall be the basis of the design and each component selected shall address the infrastructure requirements.

C. Description:
   1. In new installations (Greenfield), Sub-contractor shall develop and submit for approval a labeling strategy based on the TIA 606-B Circuit Designation and Labeling Standard.
   2. All labels shall be machine-manufactured by a labeling machine. Handwritten labels will not be accepted for final labeling.
   3. The intention of the labeling scheme is to be TIA/EIA 606-B compliant.

4. It is the responsibility of the sub-contractor to acquire, understand, and utilize the Contracting Agency's labeling scheme for all component of the voice data communications system.
5. It is the responsibility of the sub-contractor to provide labels sized to show the Contracting Agency's labeling scheme in readable font size while still matching the specified hardware identification dimensions.
6. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

D. Indoor Copper and Fiber optic cables and grounding conductors:
1. The cable sheaths shall be labeled with laser-printed polyester self-laminating wrap around labels sized to fit the Contracting Agency's labeling scheme in readable font size.

E. Horizontal cable outlet housings and faceplates:
1. Cable termination connectors at each position on the outlet housing shall be labeled with laser-printed polyester labels inserted into the outlet housing labeling window.

F. Copper patch panels:
1. The patch panels shall be labeled on the front and rear top left corner with a laser- printed polyester self-laminating label sequentially identifying the patch panel.

G. Copper patch termination blocks:
1. The termination blocks shall be labeled on the front rows with the termination block designation strip colored per the BICSI requirements identifying the copper cable pairs.

H. Fiber optic termination panels and housings:
1. The panels and housings shall be labeled on the outside front and rear top left corner with a laser-printed polyester self-laminating label sequentially identifying the panel.
2. Cable termination identifier and fiber positions inside the termination panels shall be made using the manufacturer's provided label card behind the plastic panel.

I. Equipment racks:
1. Bakelite plastic label engraved with rack label scheme attached to front and rear facing top angle bracket.
2. Label shall be adhesive backed for secure placement. Optional mounting with self-tapping screws will be at the discretion of Contracting Agency.

J. Equipment cabinets:
1. Bakelite plastic label engraved with cabinet label scheme attached to top front and rear facing frame of cabinet.
2. Label shall be adhesive backed for secure placement. Optional mounting with self-tapping screws will be at the discretion of Contracting Agency.

K. Indoor Conduits and pullboxes:
1. Each section of conduit shall be labeled on the outside facing and unobstructed view with a laser-printed polyester self-laminating label sequentially identifying the conduit and its origin and termination end (to and from).
2. Each pullbox shall be labeled on the outside door panel facing and unobstructed view with a laser-printed polyester self-laminating label sequentially identifying the pullbox and building location.

EXECUTION

2.03 EXAMINATION

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section.

2.04 INSTALLATION

A. Process:
1. The Contracting Agency-provided labeling scheme is intended to comply with TIA/EIA 606-B standard for labeling and administration of a cable plant. It is the responsibility of the sub-contractor to acquire, understand, and utilize the Contracting Agency's labeling

scheme for all component of the voice data communications system including, but not limited to:

2. Indoor Horizontal copper and fiber optic cables (Identify at both ends within 6-inches of termination).
3. Indoor copper and fiber optic backbone cables (Identify at both ends within 12-inches of the point that the cable enters termination panels/blocks, within 12- of the point that the cable enters or exits pullboxes, wall and floor sleeves.
4. Workstation outlets, faceplates and individual outlet connectors.
5. Termination panels.
6. Termination blocks.
7. Racks, cabinets, and equipment enclosures. (front and rear).
8. Indoor conduit pathways and pullboxes.
9. Grounding conductors and ground bars.
10. Label each component with a specified label at an unobstructed view location and where it is accessible for administration.

2.05 RE-INSTALLATION

A. No additional burden to the Contracting Agency regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components. Scheduling for re-installation work shall be coordinated, in writing, with the Contracting Agency prior to beginning any re- installation work.

2.06 CLOSEOUT ACTIVITIES

A. Sub-contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the Contracting Agency and A/E team.

B. Sub-contractor to submit all as-built drawings and any test documentation required prior to acceptance by the Contracting Agency.

END OF SECTION 27 05 53

This page intentionally left blank

SECTION 27 11 16

CABINETS, RACKS, ENCLOSURES FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provides specifications for network cabinets, racks, and telecommunications enclosure components utilized to house various telecommunications infrastructure components and systems equipment.

B. Equipment Racks

1.02 RELATED DOCUMENTS

A. Section 27 05 00 and all divisions of the specification and general provisions of the Construction Documents.

B. Architectural, mechanical, electrical, and all technology drawings.

C. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

1.03 CLOSEOUT SUBMITTALS

A. As-Built Drawings:
   1. Submit all as-built drawings in accordance with the general requirements of the construction documents.
   2. Submit as-built drawings a minimum of two (2) weeks after completion of all Division- 27 work for A/E and Contracting Agency reference:

1.04 QUALITY ASSURANCE

A. Qualifications – Manufacturer
   1. Component manufactures shall be ISO 9001:2000 and offer products that are RoHS compliant.

B. Qualifications – Installer:
   1. At a minimum, seventy-five percent (75%) of the onsite contractor provided field technicians shall be factory certified within 12 months by the manufacturer of the selected telecommunications system components being installed. Proof of certification shall be available on site for review at all times for each field technician.

PART 2 PRODUCTS

2.01 CABINETS, RACKS, ENCLOSURES

A. Basis-of-Design Product: Subject to compliance with requirements:
   1. Chatsworth Products Incorporated
   2. Middle Atlantic
   3. Approved equal

B. Product Options:
   1. The indicated manufacturers shall be the basis of the design and each component selected shall address the particular infrastructure requirements.

C. Description:
   1. New cabinet and cabinet components shall be black in color. Finish shall be powder coat.
   2. Network equipment will mount on to a network equipment suited cabinet 45u or 40u rack units tall, 24 Wide, and 42” and/or32” deep.
   3. Floor mounted racks shall be permanently attached, per structural engineer or manufacturer requirements, to the floor using lag bolt and lag shields for masonry type floors or appropriate fastening hardware for other types of flooring as approved by the Contracting Agency. Racks installed adjacent to each other will be fastened together using proper bolt, nut, and washer combinations.
   4. Rated load for equipment cabinets shall be no less than 2500 pounds.

5. Ladder rack shall be fastened using the proper hanging and connecting hardware, secured in a manner consistent with recommended weight load spacing recommendations.
6. Patch panels, wire cable management hardware, and other related passive equipment will be attached to racks and mounting rails with at least two screws per mounting bracket and located in accordance with the Rack/Cabinet Equipment Elevation Form contained in project documentation on a per job basis.
7. All equipment shall be free from imperfections and defects.
8. All cabinets and racks shall be grounded and bonded to specification of BICSI, Telecommunications Methods Manual and ANSI/NECA/BICSI 607 (2011) Bonding and Grounding Standard or BICSI-ITSM (2015). See grounding section in this document for details.
9. Active equipment shall be positioned in racks and cabinets to work in accordance of the “hot aisle/cold aisle” configuration of that room.
10. Equipment with intake/exhaust patterns other than front-to-back should be remediated with appropriate passive ducts to correct airflow to front-to-back pattern wherever possible.
11. Any rack/cabinet spaces not used should be filled with blank panels to minimize rogue backflow of air within the facility.
12. All racks and cabinets shall have a minimum of 3 feet clearance in the front, with 4 feet being preferable for the movement and installation of equipment. Some equipment may require more clearance. See project documentation or equipment manufacturer’s guidelines for details.
13. All racks and cabinets shall have a minimum of 2 feet clearance in the rear, with 3 feet being preferable for the movement and installation of equipment.
14. Each cabinet enclosure shall have a rectangular frame with removable top panel, side panels and doors. Installed cabinets shall include thermal, power, and cable management accessories that control airflow through the cabinet and keep network and power cables separate and organized.
15. Provide various configurable size blanking panels for each equipment cabinet.
16. The cabinet frame shall be rectangular with four corner posts, manufactured from steel with welded and bolted frame construction. The horizontal frame members shall be steel extrusion with grooves that accept captive hardware to allow attachment of equipment mounting rails and thermal, cable and power management accessories. The captive hardware will slide within the groove allowing rails and accessories to be adjusted in depth without removal from the cabinet. The slide extrusions will be marked with a scale that allows easy top-to-bottom alignment of mounting rails and other accessories when adjusted in depth.
17. Each cabinet shall include two pairs of equipment mounting rails. Mounting rails shall bolt to the side of the cabinet frame at the top and bottom of the frame and shall be adjustable in depth to provide front and rear support for equipment.
18. Equipment Mounting Rails shall be spaced horizontally to support 19” wide EIA-310- D compliant rack-mount equipment. Each RMU will be marked and numbered on the front mounting rails.
19. Attachment points will be M5/M6cage nuts or 10-32/10-24 threaded rails. Mounting rails shall be square-punched according to the ANSI/EIA-310-D Universal hole pattern. The cabinet will include assembly and equipment-mounting hardware. Each cabinet will include (50) each combination pan head, pilot point mounting screws.
20. The cabinet shall include a solid top panel with four cable access ports located near the front and rear corners of the frame. Each cable access port shall be plastic with a brush seal to allow easy addition and removal of cables while limiting bypass airflow.
21. The cabinet shall include two locking solid side panels with spring loaded latches for easy installation and removal. The cabinet shall be designed to allow baying with or without side panels installed.
22. The sides of the equipment-mounting channels will be punched to allow attachment of equipment support rails, vertical power strips and cable managers along the sides of the rack or for rack-to-rack baying

23. The cabinet shall include a single front door with a high air flow perforated metal panel, hidden tamper-resistant hinges with quick-release hinge pins and a swing handle. The door shall be removable and reversible to open from the right or left. The door shall open to 150° when the cabinet is bayed with other cabinets. The front door shall have a single-point slam latch with a keyed lock.
24. The cabinet shall include a high flow perforated metal double rear door with a swing handle. The doors shall be removable. The doors shall open to 175° when the cabinet is bayed with other cabinets. The double rear door shall have a two-point cam latch with a keyed lock.
25. The mounting rails, top panel, side panels and doors shall be electrically bonded to the cabinet frame. The cabinet frame shall have a prepared location for attaching a grounding lug.
26. The cabinet shall be UL Listed. UL Listing will be stated in the manufacturer's product literature.
27. The cabinet shall include (4) leveling feet, (4) clamps for securing the leveling feet to the floor and a grounding lug for bonding the cabinet frame to the Telecommunications Grounding Busbar. The manufacturer of the cabinet shall sell compatible casters and equipment mounting hardware as an accessory.

D. Accessory Products:
   1. Cabinet-mounted vertical power distribution units. Refer to the Division 27 11 26 specifications.

2.02 POWER REQUIREMENTS

A. Basis-of-Design Product: Subject to compliance with requirements:
   1. Hubble HBL5366C / 20A 125V

B. Contractor shall be responsible for confirming cabinets containing active equipment have installed (2) PDUs (power strips) to provide sufficient number of receptacles and current capacity to support the equipment.

C. Minimum power configuration should be no less than 20 A, 120 Vac power, with 208 Vac where needed. All circuits shall be on the same phase of power, coordinate phase requirements when circuits are fed from UPS or transformer. Consult project documentation for details on power needs of specific racks and cabinets.

D. Power circuits should have dedicated neutral and ground conductors and no exposed on/off switch or breaker controls that might cause accidental shut-off.

E. 120Vac Power circuits should have dedicated neutral and ground conductors and no exposed on/off switch or breaker controls that might cause accidental shut-off.

2.03 EQUIPMENT RACKS

A. Basis-of-Design Product: Subject to compliance with requirements:
   1. CPI
      a. 2-Post
      b. 4-Post

B. Product Options:
   1. The indicated manufacturers shall be the basis of the design and each component selected shall address the particular infrastructure requirements.

C. Description:
   1. Equipment racks and rack components shall be black in color. Finish shall be powder coat.
   2. Universal Free Standing 2-Post Relay Racks shall be aluminum, able to support and organize electronic equipment, cross-connection and/or termination hardware for fiber optic cabling, station cabling, riser cabling, or building entrance cabling as may be required by design.

3. Free Standing 4-Post Relay Racks shall be steel, aluminum, or combination of both steel and aluminum, able to support and organize electronic equipment, cross-connection and/or termination hardware for fiber optic cabling, station cabling, riser cabling, or building entrance cabling as may be required by design.
4. The assembled rack will measure 84”H x 20.3”W x 29 or 36””D. The sides of the equipment- mounting channels will be punched to allow attachment of vertical cable managers along the sides of the rack or for rack-to-rack baying.
5. Racks shall be manufactured from aluminum and/or steel extrusions.
6. Each rack will have two L-shaped top angles, two L-shaped base angles and two C-shaped equipment-mounting channels. The rack will assemble with bolt hardware. Equipment-mounting channels will be threaded for easy assembly. The base angles will be pre-punched for attachment to the floor.
7. Equipment mounting channels will be 3” deep and punched on the front and rear flange with the ANSI/EIA-310-D Universal hole pattern to provide 45 rack-mount spaces for equipment. Each mounting space will be marked and numbered on the mounting channel.
8. The rack will be UL Listed.
9. Network equipment will mount on to a network equipment suited cabinet 45u rack units tall.
10. Floor mounted racks shall be permanently attached to the floor using lag bolt and lag shields for masonry type floors or appropriate fastening hardware for other types of flooring as approved by the Contracting Agency. Racks installed adjacent to each other will be fastened together using proper bolt, nut, and washer combinations.
11. Rated load for equipment cabinets shall be no less than 1000 pounds, equipment evenly distributed along height of rack.
12. Ladder rack shall be fastened using the proper hanging and connecting hardware, secured in a manner consistent with recommended weight load spacing recommendations.
13. Patch panels, wire cable management hardware, and other related passive equipment will be attached to racks and mounting rails with at least two screws per mounting bracket and located in accordance with the Rack Equipment Elevation Form contained in project documentation on a per job basis.
14. All equipment shall be free from imperfections and defects.
15. All racks shall be grounded and bonded to specification of BICSI, Telecommunications Methods Manual and ANSI/TIA 607-B Bonding and Grounding Standard. See grounding section in this document for details.
16. Active equipment shall be positioned in racks to work in accordance of the “hot aisle/cold aisle” configuration of that room.
17. Equipment with intake/exhaust patterns other than front-to-back should be remediated with appropriate passive ducts to correct airflow to front-to-back pattern wherever possible.
18. Any rack/cabinet spaces not used should be filled with blank panels to minimize rogue backflow of air within the facility.
19. All racks and cabinets shall have a minimum of 3 feet clearance in the front, with 4 feet being preferable for the movement and installation of equipment. Some equipment may require more clearance. See project documentation or equipment manufacturer’s guidelines for details.
20. All racks shall have a minimum of 3 feet of clearance in the rear for the movement and installation of equipment.
21. Equipment Mounting Rails shall be spaced horizontally to support 19” wide EIA-310- D compliant rack-mount equipment. Each RMU will be marked and numbered on the front mounting rails.
22. Attachment points will be threaded with 12-24 roll-formed threads. The rack will include assembly and equipment-mounting hardware. Each rack will include (50) each combination pan head, pilot point mounting screws
23. The cabinet shall be UL Listed. UL Listing will be stated in the manufacturer’s product literature.

D. Accessory Products:
   1. Cabinet-mounted vertical power distribution units. Refer to the Section 27 11 26.

PART 3 EXECUTION

3.01 EXAMINATION

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section.

3.02 INSTALLATION

A. Process:
   1. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section. Examples of work which must be checked include, but are not limited to:
      a. Electrical requirements (conduit installation and capacity).
      b. The telecommunications rooms are the size indicated in the project drawings.
      c. Adequate clearances of doors, riser spaces and ceilings for all component of the telecommunications system.
      d. Examine and compare the telecommunications drawings and specifications with the drawings and specifications of other trades. Report any discrepancies between them to the A/E and obtain written instructions for changes or revisions.
   2. Assemble racks and cabinets according to manufacturer's instructions. Verify that equipment mounting rails are positioned properly for rack-mount equipment before attaching the rack to the floor.
   3. Anchor all racks and cabinets to the concrete floor per the structural requirements and cross brace to the cable runway system above.
   4. Racks shall be grounded to the TGB using appropriate hardware provided by the contractor. The ground will meet local code requirements and will be approved by the Authority Having Jurisdiction (AHJ).
   5. Ladder rack may be attached to the top of the rack to deliver cables to the rack. The rack should not be drilled to attach ladder rack. Use appropriate hardware from the ladder rack manufacturer.

3.03 RE-INSTALLATION

A. No additional burden to the Contracting Agency regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components. Scheduling for re-installation work shall be coordinated, in writing, with the Contracting Agency prior to beginning any re- installation work.

3.04 CLOSEOUT ACTIVITIES

A. Contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the Contracting Agency and A/E team.

B. Contractor to submit all as-built drawings and any test documentation required prior to acceptance by the Contracting Agency.

END OF SECTION 27 11 16

This page intentionally left blank

SECTION 27 11 19

TERMINATION BLOCKS AND PATCH PANELS FOR COMMUNICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provides specifications for wall and rack/cabinet-mounted blocks, termination panels and patch panel components utilized to terminate various telecommunications infrastructure cabling and connectivity.

B. Optical Fiber Termination panels.

C. Copper horizontal cabling Patch Panels.

1.02 RELATED DOCUMENTS

A. Section 27 05 00 and all divisions of the specification and general provisions of the Construction Documents.

B. Architectural, mechanical, electrical, and all technology drawings.

C. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

1.03 ACTION SUBMITTALS

A. Product Data: For each product indicated.
   1. Submit all product data in accordance with general requirements of the construction documents.
   2. Submit product cut sheets and a detailed list of components a minimum of two (2) weeks prior to commencement of Division-27 work for A/E review and action.
   3. Alternate and “Or Equal” designated products must be submitted for review and judgment to the A/E prior to installation. The contractor-proposed alternate products or components must be verified by two (2) independent sources within the past 6 months. This request shall include the two (2) independent sources, the original Product’s specification sheet, the proposed substitute product cut sheet, and a written request to review the substitute product.
   4. Any request of an alternate or substitution must be submitted to the A/E for action no later than fourteen (14) calendar days after release of the original telecommunications bid documents.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:
   1. Submit all shop drawings in accordance with the general requirements of the construction documents.
   2. Submit shop drawings a minimum of two (2) weeks prior to commencement of Division-27 work for A/E review and action.
   3. Shop drawings shall include evidence of grounding and bonding components are coordinated with field conditions and the work of other trades.
   4. This submittal may have a written component and a visual, drawn component for review and action by the A/E prior to installation.

B. Certificates:
   1. Submit management and installation team reference documentation verifying:
      a. The project manager is a RCDD in good standing with BICSI and is qualified to manage the scope of work described in the contract documents and has five (5) years of experience managing similar projects in size and scope. The documentation shall include the RCDD registration number.
      b. The field supervisor is a BICSI trained technician that is qualified to perform and oversee the work described in the contract documents

C. Qualification Statements:
   1. The contractor shall submit documentation that within the past 12 months, a minimum of 75% of all installation personnel have been trained or certified by the manufacturer of the products they are installing.

1.05 CLOSEOUT SUBMITTALS

A. As-Built Drawings:
   1. Submit all as-built drawings in accordance with the general requirements of the construction documents.
   2. Submit as-built drawings a minimum of two (2) weeks after completion of all Division- 27 work for A/E and Contracting Agency reference:

1.06 QUALITY ASSURANCE

A. Qualifications – Manufacturer
   1. Component manufactures shall be ISO 9001:2000 and offer products that are RoHS compliant.

B. Qualifications – Installer:
   1. At a minimum, seventy-five percent (75%) of the onsite contractor provided field technicians shall be factory certified within 12 months by the manufacturer of the selected telecommunications system components being installed. Proof of certification shall be available on site for review at all times for each field technician.

PART 2 PRODUCTS

2.01 OPTICAL FIBER TERMINATION PANELS

A. Basis-of-Design Product: Subject to compliance with requirements:
   1. Corning
   2. Or Approved

B. Product Options:
   1. The indicated manufacturers shall be the basis of the design and each component selected shall address the particular infrastructure requirements.

C. Description:
   1. 19-inch Rack mountable fiber optic termination shelf with maximum 12 panels slots with integrated splicing for termination inside Telecom rooms.
   2. Minimum 1U rack units' height, maximum 4U rack units'.
   3. Optical fiber termination panel housings shall be provided for cross-connecting or inter-connecting purposes between OSP, Indoor riser backbone, and/or distribution cables and the active network electronic switches, as noted in drawings.
   4. Single mode termination: Fusion splice both ends of each single mode fiber optic strand onto factory connectorized single mode pigtails mounted in connector housings assembled by the manufacturer of the single mode fiber optic cable.
      a. Single-Mode splice-on Connector is acceptable.
   5. Multimode termination: Terminate both ends of each multimode fiber optic strand onto field installable anaerobic type connectors.
   6. All optical fiber housings shall be complete factory-provided assemblies that contain all components including LC duplex connector adapter panels and internal/external bend radius, strain relief and cable clamp components that are provided in a housing which includes an accessible rear access hatch.
   7. All optical fiber patch panel trays and associated bulkhead inserts shall have factory numerical labeling included in the design and presentation to the user side of the panel.
   8. The optical fiber patch panel bulkheads that house the terminating modules for the fiber backbone cabling and any horizontal optical fiber cabling shall accept TIA 568-C standard-compliant LC-connectors compatible with the optical fiber strands being terminated.

D. Accessory Products:
   1. Provide any accessory products related to the optical fiber termination panels to provide a complete and functional infrastructure system.

2.02 COPPER HORIZONTAL CABLING PATCH PANELS

A. Manufacturer List:
   1. Manufacturer
      a. Category 6A 48 Port

B. Product Options:
   1. The indicated manufacturers shall be the basis of the design and each component selected shall address the particular requirements for each situation.

C. Description:
   1. All patch panels are to be rack/cabinet mountable within industry standard TIA/EIA 19” mounting rails unless otherwise noted.
   2. All patch panels are to provide adequate space for individual port labeling on the front and cable/connector labeling on the back.
   3. All installed station cable patch panels shall be Category 6A forty-eight (48) port flat patch panels
   4. All multi-pair backbone OSP cables terminated in a TR shall be terminated on a BEC protection block, unless otherwise noted on drawings. Reference Division 270526 specification.
   5. The performance criteria for the patch panels must meet or exceed the performance parameters for frequency, attenuation, near end cross-talk (NEXT), attenuation to cross-talk ratio (ACR), power sum NEXT (PS-NEXT), power sum ACR (PS-ACR), equal level far end cross-talk (ELFEXT), power sum far end cross-talk (PS-FEXT), and return loss (RL) as set forth in TIA/EIA 568-C category standards.

D. Accessory Products:
   1. Provide any accessory products related to the patch panels to provide a complete and functional infrastructure system.
   2. Where required, provide RJ-45 jack block out device to safely secure access to unused ports and deter vandalism to jacks.
   3. Provide complete with all required mounting hardware and fittings and cables needed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section. Examples of work which must be checked include, but are not limited to:
   1. Electrical requirements (conduit installation and capacity)
   2. The telecommunications rooms are the size shown on the project drawings.
   3. Adequate clearances of doors, riser spaces and ceilings for all component of the telecommunications system.
   4. Examine and compare the telecommunications drawings and specifications with the drawings and specifications of other trades. Report any discrepancies between them to the A/E and obtain written instructions for changes or revisions.

3.02 INSTALLATION

A. Process:
   1. Install all optical fiber and category copper termination panels/panels under the guidelines of the manufacturer’s recommended instructions and per all TIA/EIA 568-C standards and manufacturer-approved industry practices as shown in the drawings.

2. The installation and performance parameters of all installed cable termination panels shall be verified by the contractor through ANSI/TIA 568-C testing procedures.
3. Label all cable termination panels to identify each port and each specific panel in accordance with the TIA/EIA 606 labeling scheme approved by the Contracting Agency.

B. Installation description:
1. Contractor shall use existing cabling management pathways and take care to place cable like with like, maintaining original segregation strategies for separating fiber and copper cables as well as any separation necessary between different types of copper cables.
2. Cables shall be dressed neatly within patch management pathways with care taken to maintain minimum bend radius of not less than 1 times the cord outer diameter for copper and not less than a 1" bend radius for fiber jumpers as per ANSI/TIA 568-C.0
3. The installation and performance parameters of all installed cable termination panels shall be verified by the contractor through ANSI/TIA 568-C testing procedures.
4. Label all cable termination panels to identify each port and each specific panel in accordance with the TIA/EIA 606 labeling scheme approved by the Contracting Agency.

3.03 RE-INSTALLATION

A. No additional burden to the Contracting Agency regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components due to manufacturer defects or contractor poor performance. Scheduling for re- installation work shall be coordinated, in writing, with the Contracting Agency prior to beginning any re- installation work.

3.04 CLOSEOUT ACTIVITIES

A. Contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the Contracting Agency and A/E team.

B. Contractor to submit all as-built drawings and any test documentation required prior to acceptance by the Contracting Agency

END OF SECTION 27 11 19

SECTION 27 11 26

POWER DISTRIBUTION UNIT (PDU)

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Provides specifications for the provision and installation of power distribution units with-in rack or cabinet frames within telecommunications distribution spaces.
   2. Vertical mount Power Distribution Units
   3. Rack mount Horizontal Power Distribution Units

1.02 RELATED DOCUMENTS

A. Section 27 05 00 and all divisions of the specification and general provisions of the Construction Documents.

B. Architectural, mechanical, electrical, and all technology drawings.

C. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

1.03 CLOSEOUT SUBMITTALS

A. As-Built Drawings:
   1. Submit all as-built drawings in accordance with the general requirements of the construction documents.
   2. Submit as-built drawings a minimum of two (2) weeks after completion of all Division- 27 work for A/E and Owner reference:

1.04 QUALITY ASSURANCE

A. Qualifications – Manufacturer
   1. Component manufactures shall be ISO 9001:2000 and offer products that are RoHS compliant.

B. Qualifications – Installer:
   1. At a minimum, seventy-five percent (75%) of the onsite contractor provided field technicians shall be factory certified within 12 months by the manufacturer of the selected telecommunications system components being installed. Proof of certification shall be available on site for review at all times for each field technician.

PART 2 PRODUCTS

2.01 HORIZONTAL POWER DISTRIBUTION UNITS

A. Basis-of-Design Product: Subject to compliance with requirements:
   1. CPI
   2. APC
   3. Raritan
   4. Or equal

B. Product Options:
   1. The indicated manufacturers shall be the basis of the design and each component selected shall address the particular infrastructure requirements.

C. Horizontal Power Distribution Unit Product Description:
   1. Quantity: two (2) per IDF/MDF rack.
   2. Output:
      a. Nominal Output Voltage 120V
      b. Maximum Total Current Draw per Phase 20A
      c. Output Connections C13, C19 and NEMA 5-20R
      d. Default setting are always in the on position.

3. Input
    a. Nominal Input Voltage 120V
    b. Input Frequency 50/60 Hz
    c. Regulatory derated Input Current (North America) 16A for 20A - 80% of (rated) value.
    d. Input Connections NEMA L5-20P (from UPS)
    e. Minimum Cord Length 9 feet
    f. Number of Power Cords (1)
    g. Maximum Input Current per phase 20A

D. Local Current Monitoring Display
1. The aggregate current draw per power distribution unit is displayed on the unit via a digital display. The local digital display helps installers avoid overloaded circuits by providing a visible warning when the current draw is close to the maximum amperage draw of the strip.

E. Physical
1. Height 1.75 inches
2. Width 17.50 inches
3. Depth 4.25 inches
4. 1 RU

F. Conformance and Regulatory Approvals
1. CSA
2. FCC Part 15 Class A
3. ICES-003
4. UL 60950

G. Accessory Products:
1. The indicated manufacturers shall be the basis of the design and each component selected shall address the particular infrastructure requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section. Examples of work which must be checked include, but are not limited to:
1. Electrical requirements (conduit installation and capacity).
2. The telecommunications rooms are the size shown on the project drawings.
3. Adequate clearances of doors, riser spaces and ceilings for all component of the telecommunications system.
4. Examine and compare the telecommunications drawings and specifications with the drawings and specifications of other trades. Report any discrepancies between them to the A/E and obtain written instructions for changes or revisions.

3.02 INSTALLATION

A. Process:
1. Install all power distribution units per the manufacturer’s recommended installation instructions.
2. Provide one (1) horizontal (to each rack) power units per PDU electrical circuit requested.
3. Secure power distribution units and other accessories using appropriate factory manufactured screws.
4. Align devices with rack or cabinet hole patterns to allow for installation of screws in all mounting holes. Hand-tighten screws to factory limits being careful not to over tighten, cross thread or strip screw heads.
5. Final location of each power distribution unit to be coordinated with the designer and the owner.
6. All rack and cabinet-mounted vertical power strips shall be provided with rear facing stand off or internal cabinet mounting brackets that are both offset to the side of the mounting

rails so as not to interfere with the equipment mounted within the rack and provided with sufficient depth to allow access to the vertical and horizontal wire managers.

7. Contractor shall verify with OAR as to PDU facing front/rear of cabinet/rack.

3.03 RE-INSTALLATION

A. No additional burden to the owner regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components. Scheduling for re-installation work shall be coordinated, in writing, with the owner prior to beginning any re-installation work

3.04 CLOSEOUT ACTIVITIES

A. Contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the Owner and A/E team.

B. Contractor to submit all as-built drawings and any test documentation required prior to acceptance by the Owner

END OF SECTION 27 11 26

This page intentionally left blank

SECTION 27 13 13

COMMUNICATIONS COPPER BACKBONE CABLING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provides specifications for high pair count UTP copper backbone cabling to distribute network signals between telecommunications distribution spaces.

B. Backbone Multi-Pair UTP Cable.

1.02 RELATED DOCUMENTS

A. Section 27 05 00 and all divisions of the specification and general provisions of the Construction Documents.

B. Architectural, mechanical, electrical, and all technology drawings.

C. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

1.03 CLOSEOUT SUBMITTALS

A. Warranty Documentation:
   1. Submit manufacturers extended warranty certification documentation one (1) week after the warranty acceptance by the manufacturer. It shall be the contractor's responsibility to facilitate the manufacturer-specific warranty requirements

B. As-Built Drawings:
   1. Submit all as-built drawings in accordance with the general requirements of the construction documents.
   2. Submit as-built drawings a minimum of two (2) weeks after completion of all Division- 27 work for A/E and Contracting Agency reference:

1.04 QUALITY ASSURANCE

A. Qualifications – Manufacturer
   1. Component manufactures shall be ISO 9001:2000 and offer products that are RoHS compliant.

B. Qualifications – Installer:
   1. At a minimum, seventy-five percent (75%) of the onsite contractor provided field technicians shall be factory certified within 12 months by the manufacturer of the selected telecommunications system components being installed. Proof of certification shall be available on site for review at all times for each field technician.

PART 2 PRODUCTS

2.01 BACKBONE MULTI-PAIR CABLING

A. Basis-of-Design Product: Subject to compliance with requirements:
   1. General Cable
   2. Superior Essex
   3. Or Approved Equal

B. Product Options:
   1. The indicated manufacturers shall be the basis of the design and each component selected shall address the particular infrastructure requirements.

C. Description:
   1. All voice and data ISP and OSP copper backbone cable is to be rated per the constructed conditions and verified by the contractor prior to installation. Per code, plenum cable is to be installed at all times when a communications cable is exposed in a plenum air space. It is the responsibility of the contractor to bid, purchase, install, and verify the rating of the ISP and OSP cable for the specific construction conditions.

2. Backbone cables that are exposed to moisture shall contain moisture-blocking materials to prevent moisture damage to cable performance.
3. Backbone multi-pair UTP cable shall be Category-3 copper UTP, twenty-four (24) AWG cable.
4. The performance criteria for the UTP backbone cable shall be in accordance with the specific standards for the particular cable's rating. A category-3 rated cable must perform up to, or beyond the current specification parameters for the published category-3 rating by TIA/EIA 568-C.2.
5. Installed cable shall have appropriate cable construction, including external jacket properties, when installing cables in aerial, outdoor, underground and corrosive environments.

D. Accessory Products:
1. Provide any accessory products related to the UTP copper backbone cabling required to provide a complete and functional infrastructure system.

PART 3 EXECUTION

3.02 EXAMINATION

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section. Examples of work which must be checked include, but are not limited to:
1. Electrical requirements (conduit installation and capacity)
2. The telecommunications rooms are the size shown on the project drawings.
3. Adequate clearances of doors, riser spaces and ceilings for all component of the telecommunications system.
4. Examine and compare the telecommunications drawings and specifications with the drawings and specifications of other trades. Report any discrepancies between them to the A/E and obtain written instructions for changes or revisions.

3.03 INSTALLATION

A. Process:
1. Install all copper backbone/station cable per the manufacturer's recommended installation instructions, under the guidelines of TIA/EIA 568 C and BICSI, and in quantities indicated in the LV series drawings.
2. Install all cables with proper attention paid to bend radii, pulling method, attachment method, and pulling forces. The cable manufacturer's specifications for each particular cable type shall be followed exactly.
3. Backbone cable shall be visually inspected for insufficient bend radius during and after pulling. Damaged cables, or those installed under questionable methods and/or circumstances shall be replaced at no additional cost to the Contracting Agency.
4. All cable shall be pulled using an appropriate measuring device to ensure that the specified force is not exceeded as noted in manufacture installation guidelines.
5. Install backbone cables with attention paid to aesthetic means and methods when routing cabling within IT spaces.
6. No backbone cable shall be left unsupported for more than four (4) feet, three (3) feet preferred, vertically or horizontally at any time.
7. All backbone cables shall be clearly labeled on both ends and in an accessible location no more than one (1) foot from each cable end.

3.04 RE-INSTALLATION

A. No additional burden to the Contracting Agency regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components. Scheduling for re-installation work shall be coordinated, in writing, with the Contracting Agency prior to beginning any re- installation work

3.05 CLOSEOUT ACTIVITIES

A. Contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the Contracting Agency and A/E team.

B. Contractor to submit all as-built drawings and any test documentation required prior to acceptance by the Contracting Agency.

END OF SECTION 27 13 13

This page intentionally left blank

SECTION 27 13 23

COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provides specifications for optical fiber backbone cabling to distribute optical network signals between telecommunications distribution spaces and equipment.

B. Backbone Single-mode Optical Fiber Cable.

C. Backbone Multi-Mode Optical Fiber Cable.

1.02 RELATED DOCUMENTS

A. Section 27 05 00 and all divisions of the specification and general provisions of the Construction Documents.

B. Section 27 15 15 for powered fiber specification.

C. Architectural, mechanical, electrical, and all technology drawings.

D. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

1.03 CLOSEOUT SUBMITTALS

A. As-Built Drawings:
   1. Submit all as-built documentation in accordance with the general requirements of the construction documents.
   2. Cabling as-built drawings must contain detailed location and identification information coordinated with the as-built cable schedules.
   3. All cabling must meet or exceed applicable TIA/EIA testing requirements and any additional parameters outlined in the Commissioning of Communications specification Section 27 08 00.
   4. Test results must be submitted for Contracting Agency review and approval adhering to the General Contractor schedule milestones related to the projects active systems integration.

1.04 QUALITY ASSURANCE

A. Qualifications – Manufacturer
   1. Component manufactures shall be ISO 9001:2000 and offer products that are RoHS compliant.

B. Qualifications – Installer:
   1. At a minimum, seventy-five percent (75%) of the onsite contractor provided field technicians shall be factory certified within 12 months by the manufacturer of the selected telecommunications system components being installed. Proof of certification shall be available on site for review at all times for each field technician.

PART 2 PRODUCTS

2.01 BACKBONE MULTI-MODE/SINGLE-MODE OPTICAL CABLING

A. Basis-of-Design Product: Subject to compliance with requirements:
   1. Corning.

B. Product Options:
   1. The manufacturers noted above shall be the only manufacturers acceptable to the Contracting Agency and A/E. Cable construction shall be a hybrid multi-mode and single-mode fiber stands combined in a single protection jacket as indicated on the project drawings.

C. Description:
   1. All backbone OM4 LOMMF cables shall be capable of 10 Gb/s Ethernet signal transmission to 550 meters at 3500/500 MHz/km effective modal bandwidth, while

allowing the use of low-cost, 850 nm vertical cavity surface emitting laser (VCSEL). Maximum attenuation for a LOMMF cable shall be no greater than 3.0dB per kilometer using 850nm and 1.0dB per kilometer using 1300nm wavelengths respectively.

2. All backbone single-mode optical fiber cable shall be capable of 10 Gb/s Ethernet signal transmission to 10,000 meters in the 1310nm operating window. Maximum attenuation for a single-mode cable shall be no greater than 0.4dB per kilometer using 1310nm and 0.3dB per kilometer using 1550nm wavelengths respectively.
3. Each optical fiber strand shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification and all EIA/TIA 568-C.3 and 568-C.3-1 performance parameters.
4. All optical fibers inside each individual cable shall be provided in counts indicated in the drawings and usable to the fullest capacity specified by the manufacturer and meet required specifications at all times.
5. Indoor/Outdoor backbone multi-mode/single-mode optical fiber cables shall be:
    a. Individual jacketed, tight buffered fiber type.
    b. Cable construction shall be a multi-mode/single-mode hybrid in a single protective outer sheath.
    c. The individual fibers are grouped in jacketed subunits color coded per TIA- 598.
    d. Have integrated dielectric central and strength members.
6. The optical fiber cables shall be rated per the installation environment as required by the local Authority Having Jurisdiction and/or National Fire Codes. Select an appropriate cable construction, including external jacket properties, when installing optical fiber cables in aerial, outdoor, underground and corrosive environments.
7. All MMF/SMF shall meet or exceed TIA compliant network cable-testing device certification by an independent laboratory, such as ETL, for verification of high speed, TIA/EIA T568C-compliant performance.

D. Cable sizes defined in Contract Documents.
1. 96-strand Single-mode mode - OSP - Outdoor Rated
2. 24-strand Single-mode / 12-strand Multi-mode – ISP – Riser Rated
3. 6-strand Single-mode mode - ISP – Riser Rated

E. Accessory Products:
1. Provide any accessory products related to the optical fiber backbone cabling required to provide a complete and functional infrastructure system.

2.02 INNDERDUCT SYSTEMS

A. Description:
1. Outside plant shall be constructed with High Density Polyethylene-rated plastic (HDPE)
2. Inside Plant shall be constructed of riser rated Polyethylene-rated plastic.
3. Shall be 25mm or 32mm in diameter as called for on the drawings or as required to provide a maximum of 40% fill.
4. Orange is an acceptable color.
5. Shall be UL listed to 2024 standard.
6. Shall be corrugated in design.
7. Shall be available with two and three-way couplers to join two ends together at pull points.

B. Products:
1. Carlon.
2. Endot.
3. Premier.

2.03 DUCT PLUGS

A. Description:
1. All Duct Plugs shall be constructed of high impact plastic components with durable elastic gaskets.
2. Shall be installed for all innerducts where water may be present.

3. Triplex and/or Quadplex Plugs shall be installed around each innerduct installed in an underground system to organize and support innerducts within conduits.
4. Fiber Optic Duct Plugs shall be installed inside each innerduct surrounding installed fiber optic cabling.
5. Shall be sized for diameter of the innerduct and fiber optic cable.
6. Expandable Plugs shall be provided within buildings for all unused underground conduits.
7. All duct plugs shall be water and airtight.

B. Acceptable Manufacturer:
1. Triplex Plugs.
2. Quadplex Plugs.
3. Fiber Optic Duct Plugs.
4. Expandable Plugs.

PART 3 EXECUTION

3.02 EXAMINATION

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section. Examples of work which must be checked include, but are not limited to:
1. Electrical requirements (conduit installation and capacity)
2. The telecommunications rooms are the size shown on the project drawings.
3. Adequate clearances of doors, riser spaces and ceilings for all component of the telecommunications system.
4. Examine and compare the telecommunications drawings and specifications with the drawings and specifications of other trades. Report any discrepancies between them to the A/E and obtain written instructions for changes or revisions.

3.03 INSTALLATION

A. Process:
1. Install all backbone cable per the manufacturer’s required installation instructions, under the guidelines of TIA/EIA 568C and BICSI, and in quantities indicated in the drawings.
2. Install all cables with proper attention paid to bend radii, pulling method, attachment method, and pulling forces. The cable manufacturer's requirement specifications for each particular cable type shall be followed exactly.
3. Backbone cable shall be visually inspected for non-compliant bend radius during and after pulling. Damaged cables, or those installed under questionable methods and/or circumstances shall be replaced at no additional cost to the Contracting Agency.
4. All cable shall be pulled using an appropriate measuring device to ensure that the specified force is not exceeded as noted in manufacturers requirements.
5. Install backbone cables with attention paid to aesthetic means and methods when routing cabling within IT spaces. No backbone cable shall be left unsupported for more than three (3) feet vertically or horizontally at any time.
6. Fiber optic cables shall be placed in neat bundles separated from other communications cabling. Fiber optic cables shall be neatly placed and bundled with Velcro ties to the horizontal and vertical cable management and runways at minimum 4-foot intervals, not to exceed every 4th rung, plus all locations where the cables change direction.
7. Provide radius drop out fittings at all locations where fiber optic cables transition from vertical to horizontal cable management systems.
8. All backbone cable shall be securely fastened to the termination shelf with a manufacturers strain relief bracket and termination panel cable clamp in a way that does not damage the optical fiber strands or impede the performance of the media. This secure fastening method shall also serve to insure a secure termination environment.
9. A minimum of three feet (3’-0”) of each optical fiber strand shall be left protected within the termination shelf for any future re-termination of a particular optical fiber strand.

10. All backbone cables shall be clearly labeled on both ends and in an accessible location no more than one (1) foot from each cable end.

3.04 RE-INSTALLATION

A. No additional burden to the Contracting Agency regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components. Scheduling for re-installation work shall be coordinated, in writing, with the Contracting Agency prior to beginning any re- installation work

3.05 CLOSEOUT ACTIVITIES

A. Contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the Contracting Agency and A/E team.

B. Contractor to submit all as-built drawings and any test documentation required prior to acceptance by the Contracting Agency

END OF SECTION 27 13 23

SECTION 27 15 13
COPPER HORIZONTAL CABLING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provides specifications for four-pair UTP copper horizontal workstation cabling to distribute network signals from telecommunications distribution spaces to work area outlet locations.

B. Category 6A CMP rated, Four-Pair Copper Cabling.

C. RG6 Coaxial CMP rated Cabling.

1.02 RELATED DOCUMENTS

A. Section 27 05 00 and all divisions of the specification and general provisions of the Construction Documents.

B. Section 27 15 15 for powered fiber specification

C. Architectural, mechanical, electrical, and all technology drawings.

D. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

1.03 CLOSEOUT SUBMITTALS

A. As-Built Drawings:
   1. Submit all as-built drawings in accordance with the general requirements of the construction documents.
   2. Submit as-built drawings a minimum of two (2) weeks after completion of all Division- 27 work for A/E and Contracting Agency reference:
   3. All cabling must meet or exceed applicable TIA/EIA testing requirements
   4. Test results must be submitted for Contracting Agency review and approval adhering to the General Contractor schedule milestones related to the projects active systems integration.

1.04 QUALITY ASSURANCE

A. Qualifications – Manufacturer
   1. Component manufactures shall be ISO 9001:2000 and offer products that are RoHS compliant.

B. Qualifications – Installer:
   1. At a minimum, seventy-five percent (75%) of the onsite contractor provided field technicians shall be factory certified within 12 months by the manufacturer of the selected telecommunications system components being installed. Proof of certification shall be available on site for review at all times for each field technician.

PART 2 PRODUCTS

2.01 FOUR PAIR CATEGORY 6A CABLING

A. Basis-of-Design Product: Subject to compliance with requirements:
   a. Mohawk
   b. Commscope
   c. Berktek
   d. AMP

B. Product Options:
   1. The indicated manufacturers shall be the basis of the design and each component selected shall address the particular infrastructure requirements.

C. Description:
   1. All category-6A performance four (4) pair cable shall consist of eight (8) twenty-four (23) gauge, or greater, thermoplastic insulated solid twisted conductors that utilize the industry standard color code designations.
   2. The performance criteria for four (4) pair cable shall be above and beyond specific EIA/TIA 568-C.2 standards for the particular cable's rating and shall show stable performance with documented electrical characterization out to 500 MHz.
   3. Four (4) pair cables must perform over and above each of the current specification parameters for the latest published twisted pair, 10Gb performance cable solution.
   4. Cables shall be rated per the installation environment as required by the local AHJ and local codes.
   5. Select an appropriate cable construction, including external jacket properties, when installing cables in aerial, outdoor, underground and corrosive environments.
   6. Cable to be run continuous without splices.

D. Accessory Products:
   1. The indicated manufacturers shall be the basis of the design and each component selected shall address the particular infrastructure requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section. Examples of work which must be checked include, but are not limited to:
   1. Electrical requirements (conduit installation and capacity)
   2. The telecommunications rooms are the size shown on the project drawings.
   3. Adequate clearances of doors, riser spaces and ceilings for all component of the telecommunications system.
   4. Examine and compare the telecommunications drawings and specifications with the drawings and specifications of other trades. Report any discrepancies between them to the A/E and obtain written instructions for changes or revisions.

3.02 INSTALLATION

A. Process:
   1. Install all horizontal station cabling per the manufacturer's recommended installation instructions, under the guidelines of TIA/EIA 568C and BICSI, and in quantities indicated in the drawings.
   2. Locations requiring horizontal cable shall be, but not limited to, CCTV, Elevator control panels, work area outlet and WiFi.
   3. Install all cables with proper attention paid to bend radii, pulling method, attachment method, and pulling forces. All cable shall be pulled using an appropriate measuring device to ensure that the specified force is not exceeded as noted in BICSI installation guidelines. Also refer to the cable manufacturer's specifications for exact cable requirements per the particular cable type.
   4. All cables shall be visually inspected for insufficient bend radius during and after pulling. Damaged cables, or those installed under questionable methods and/or circumstances shall be replaced at no additional cost to the Contracting Agency.
   5. Contractor shall ensure that all TIA/EIA and industry standards are met with special regards to maximum stripping length of cable jackets. No four (4) pair UTP cables shall have more than three-eight inch (3/8") of cable jacket removed beyond the termination points.
   6. Install the horizontal cabling with attention paid to aesthetic means and methods when routing cabling within IT spaces. All horizontal cabling shall terminate in their respective floor serving technology space; specifically cables from floor outlets need to terminate in their corresponding floor telecom room.

7. All cabling distributed horizontally through metal stud framing shall have plastic protective bushings inserted to protect cables prior to installation.
8. All cables shall be clearly labeled on both ends and in an accessible location no more than six inches (0'-6") from the cable ends.
9. The Contracting Agency reserves the right to specify a new location for any outlet or equipment without increasing contractor unit cost – providing that the new location is specified prior to roughing-in of technology cable and is not farther than ten (10) feet away from the original location specified.
10. Communication EMT conduit sleeves shall receive conduit waterfall to control bend radius of the communication cable to a minimum of a 4" radius.

3.03 RE-INSTALLATION

A. No additional burden to the Contracting Agency regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components. Scheduling for re-installation work shall be coordinated, in writing, with the Contracting Agency prior to beginning any re- installation work

3.04 CLOSEOUT ACTIVITIES

A. Contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the Contracting Agency and A/E team.

B. Contractor to submit all as-built drawings and any test documentation required prior to acceptance by the Contracting Agency

END OF SECTION 27 15 13

This page intentionally left blank

SECTION 27 15 15

POWERED FIBER CABLE SYSTEM DATA COMMUNICATIONS HORIZONTAL CABLING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Sections 27 05 00, 27 15 13, 27 13 23, and all divisions of the specification and general provisions of the Construction Documents.

B. Architectural, mechanical, electrical, and all technology drawings.

C. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

1.02 INTRODUCTION

A. Introduction
   1. Provide a powered cabling solution that combines power and optical fiber communications into one complete system.
   2. The cable must combine electrical power conductors and optical fiber into one package to speed up installations and simplify power and communications delivery to devices.

B. Powered Fiber Cable System
   1. System must be a complete "rack to device" solution capable of powering and communicating with small cells, Wi-Fi hotspots, HD cameras, and variety of devices requiring optical communications and DC power in one system.
   2. The hybrid cable shall allow for "standalone" use in delivering of power and fiber data communications.
   3. When used along with the PoE extender, the powered fiber optic cable shall supply optical fiber communications and PoE+ power for network access and other low voltage DC devices.
   4. See Table 1 for cable distances by gauge and input power.

PSU O□□□□V□□□□	C□□□ G□□□□ (AWG)	L□ □□(□) P□□□ 60W (P□E /P□E)	L□ □□(□) P□□□ 45.4W (P□E/P□E)	L□ □□(□) P□□□ 30.8W (P□E/P□E)	L□ □□(□) P□□□ 30W (P□E)	L□ □□(□) P□□□ 15.4W (P□E)
Ma imum 57V	12	650	1120	1570	1595	2630
	16	255	445	620	630	1040
Nominal 48V	12	460	795	1100	1120	1840
	16	180	315	435	440	725
Minimum 40 5V	12	330	555	770	780	1285
	16	130	220	305	310	510

TABLE 1 - POE EXTENDER ELECTRIC TRANSMISSION AND RECOMMENDED CABLE LENGTH DISTANCES

   5. Must be compatible with commercially available NEC Class 2 and/or SELV compliant 48-57VDC power supply
   6. System shall comply with the following standards: a. RoHS (2002/95/EC)
      a. REACH SVHC, 536/20/11
      b. California Prop 65 for safe drinking water and toxic enforcement act
      c. Telcordia GR-20-CORE Issue 3May 2008, EIA/TIA FOTPS
      d. TIA-568-C
      e. Deca-BDE free
      f. Power limited circuit cable UL 13 (CL2R-OF AND CL3R-OF)
      g. Communication cable per UL 444 (CMR-OF)
      h. UL 1666 standard for test for flame propagation - Edition 5 - Revision date 2012/06/27 j. IEC 60332-1-1, -2, 60332-3-24 Cat. C, 6103460745-2

i. k. ITU.T K21,
j. l. GR-1089
k. m. IEC 60793-2-50 type B.1.3 and B.6.A&B
l. n. ITU-T G.657.A1 or A2/B2 optical fiber, backwards compatible with G.652.D
m. o. PoE (IEEE 802.3af-2003) and PoE+ (IEEE 802.3at-2009)
n. p. Must comply with Canadian code ICES-003

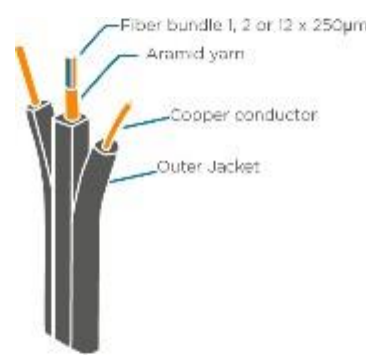
7. Equipment must comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules
8. Standard system consists of five (5) components:
   a. Hybrid fiber/copper cabling
   b. PoE Extender
      1) 1-port
      2) 2-port
   c. Power and fiber distribution element
   d. Cable and fiber management
   e. SFP connector

PART 2 PRODUCTS

2.01 MANUFACTURED COMPONENTS

A. Manufacturer List
   1. CommScope
   2. Approved equivalent

B. System Components
   1. Hybrid fiber/copper cable
      a. 12 AWG (2mm) or 16 AWG (1.2mm) conductor size
      b. 02, 04 or 12 optical fibers
      c. Singlemode or OM3 Multimode fiber type
      d. Outdoor rated polyethylene (PE) or Riser/LSZH indoor/outdoor
      e. jacket type
      f. 1 Km, 2 Km or 4 Km cable length
      g. Compatible with FOSC 450A splice closure
      h. Cable must meet specifications in Table 1 and Table 2.



E[illegible] C[illegible]	
Storage Temperature: Operating Temperature: Installation Temperature:	-40°C to +70°C -40°C to +70°C -10°C to +60°C
T[illegible] L[illegible]	
Short Term: Long Term:	440 N 132 N
P[illegible] A[illegible] B[illegible] R[illegible] ([illegible].)	
Installed: Loaded:	30 mm (1.18 in.) 50 mm (1.97 in.)
I[illegible] (N-[illegible])	
EIA/FOTP-25C	4.4 N-m
C[illegible] (N-[illegible])	
EIA/FOTP-41A	2200 N-m
O[illegible] P[illegible] ([illegible]B/K[illegible])	
Singlemode Reduce Bend Radius Fiber	0.35/0.25 dB/km (1310/1550 nm)
Multimode OM3	0.35/0.25 dB/km (1310/1550 nm)

TABLE 1
POWERED FIBER CABLE SPECIFICATIONS

C[illegible] S[illegible] (AWG)	D[illegible] (N[illegible], [illegible]) W[illegible]	H[illegible]	W[illegible] (N[illegible])

16	10.9	4	70.0 kg/km
12	12	4.5	110.0 kg/km

TABLE 2
POWERED FIBER CABLE DIMENSIONS AND WEIGHT SPECIFICATIONS

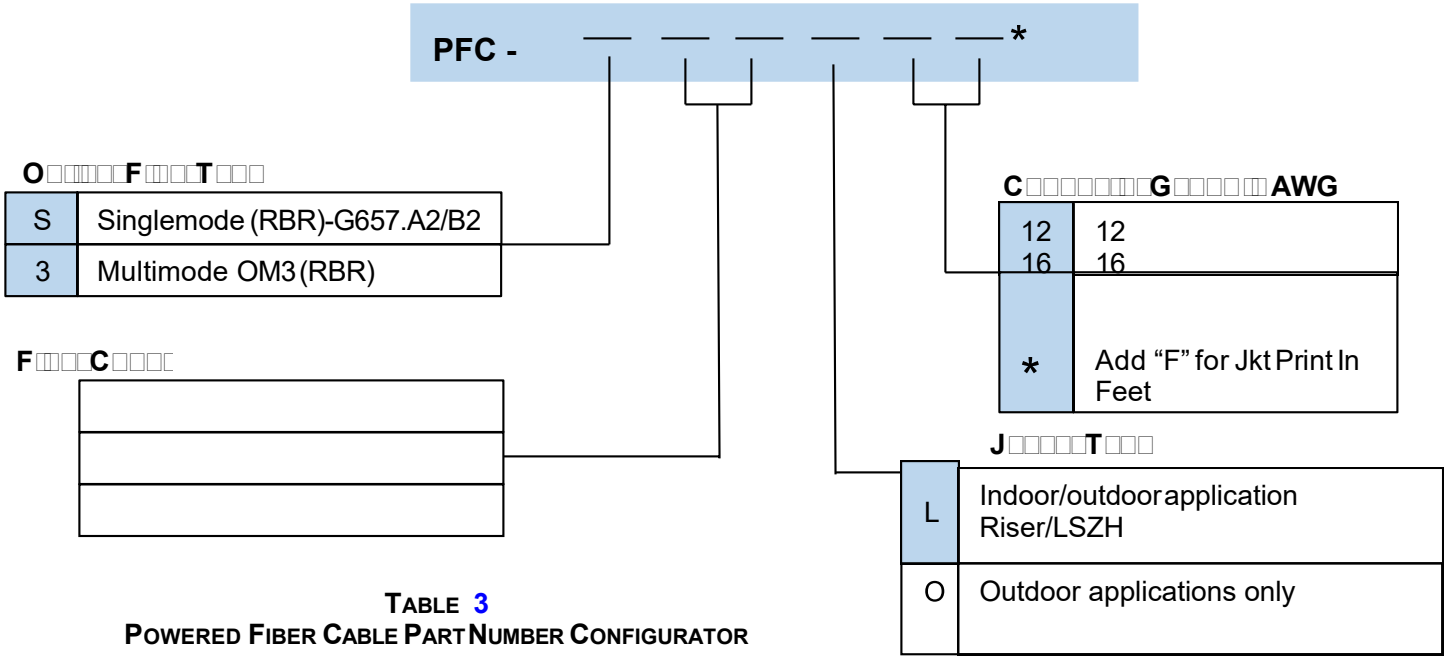


TABLE 3
POWERED FIBER CABLE PART NUMBER CONFIGURATOR

i. Cable shall be CommScope product part number (see Table 3) or approved equivalent.

2. PoE Extender
   a. Provides termination for hybrid cable input and automatically corrects voltage drop over distance
   b. Optical signal and power in must be converted to RJ45 PoE+ compliant jack(s)
   c. Shall be available in 1 or 2 port configurations
      1) 2-port configuration must allow for two (2) PoE or PoE+ devices to be connected via one hybrid cable
      2) 2-port must provide option to share the bandwidth of a single 1 Gb/s SFP or utilize two (2)
      3) SFPs for 1 Gb/s per port operation
   d. Must use outdoor rated patch cord
   e. Must be Earth grounded via a 12AWG conductor connected to the chassis ground lug.
   f. Shall be available in pole or wall mount options
   g. Extender shall have three (3) levels of electrical protection
      1) Primary - GDT component rated to 40kA surge protection
      2) Secondary - MOV components rated to 4.5kA
      3) Tertiary - TVS prevents the voltage from rising above 80-100V
   h. Termination block shall support a minimum of 200 re-terminations while maintaining a contact resistance of less than one (1) milliohm.
   i. Environmentally sealed closure rated to IP67
   j. Must provide electrical power transmission management
   k. Must be ascetically appealing for Wi-Fi access point or camera deployment
   l. SFP module in the POE extender should match module in existing switch
   m. Must include sunshade for harsh temperature installation
   n. PoE extender must meet specifications in Tables 4 and 5.

I□□□	
Storage Temperature:	-40°C to +70°C
Operating Temperature:	-40°C to +65°C
Installation Temperature:	-5°C to +45°C
65□C assumes 45□C ambient air temperature, plus 20□C sun loa in	

TABLE 4
POE EXTENDER CLIMATIC PERFORMANCE

I□□□	D□□ □□□□□□	W□□□□□
PoE Extender 1-port version	238mm x 225mm x 77mm	3.8 kg
PoE Extender 2-port version	283mm x 225mm x 77mm	3.8 kg

TABLE 5
POE EXTENDER PHYSICAL DIMENSIONS

1-PORT POE EXTENDER

2-PORT POE EXTENDER

3. Power and Fiber Distribution Element
   a. Must be compatible with GE Critical Power Express Class II shelf, DC Rectifier Shelf and Modules.
   b. Shall comply with NEC Class II and SELV
   c. Each GE Modules shall accommodate eight (8) cable outputs; each GE chassis shall contain up to four (4) modules total per power supply for a total of 32 cables per power supply;

C. Slimline SPS DC Rectifier Module

PART 3 EXECUTION

3.01 INSTALLATION

A. Install all systems in accordance with manufacturer's printed instructions, as well as all Kitsap standards.

B. The power supply shall be installed in a safe location with access to the fiber optic network into which small cells or other network access devices are desired to be connected, and either 120VAC, 240VAC.

C. Parameters to be considered prior to system deployment:
   1. Distance from power supply to the network devices
   2. Maximum power consumption of the network devices
   3. Number of devices to be deployed
   4. Type of cable (jacket, support)
   5. Fiber Management options

D. For outdoor direct burial installations, the PE-jacketed "outdoor-only" rated cable is recommended.
   1. When installing in ducts, care should be given to avoid cable twisting.
   2. Standard cable lubricants may be used to assist with conduit or duct installations.
   3. If it is not practical to bring a reel of cable to the installation site, then utilize a standard figure 8 procedure to lay the cable out prior to pulling in duct. This helps avoid cable twisting.

E. The PE-jacketed outdoor cable is rated for direct burial but for long-term reliability is recommended installing below-ground cables in conduit/ducts.

F. Powered Fiber Cable is not rated for aerial self-support thus cable lashing is recommended.

G. Use only a typical pair of wire strippers to access the powered fiber cable and, optionally, a wire cutter or snip.

H. In cases where it becomes necessary to prevent shrink back and enhance coupling the additional buffer tube coupling can be achieved by placing slack or coupling coils at each splice closure or optical tap.
   1. The size of the loop should be based on the unloaded minimum bend radius of the cable.
   2. Laboratories testing and aerial installation test site demonstrate that a total of 5 loops on the input and 5-□ loops on the output adequately enhances the coupling to prevent buffer tube movement and provide proper entry into and out of the tap per Figure 1 below.

I. The LSZH/riser rated indoor/outdoor cable may also be installed in conduits or ducts, however, frictional forces are greater for the indoor/outdoor cable and, therefore, achievable distances may be less.

J. Standard cable lubricants may be used to assist with the indoor/outdoor cable for duct installation.

K. PoE Extender port openings must be properly sealed at all times (prior, during and after installation) against weather, moisture, dust/debris. Any exposure could result in catastrophic damage to electronic components.

L. PoE Extenders and Power Shelves must be properly grounded per manufacturer's instructions.

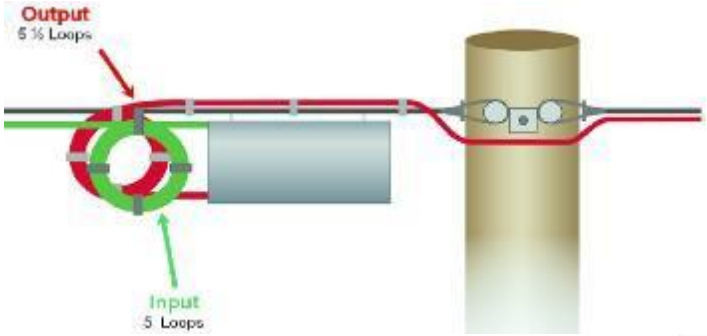
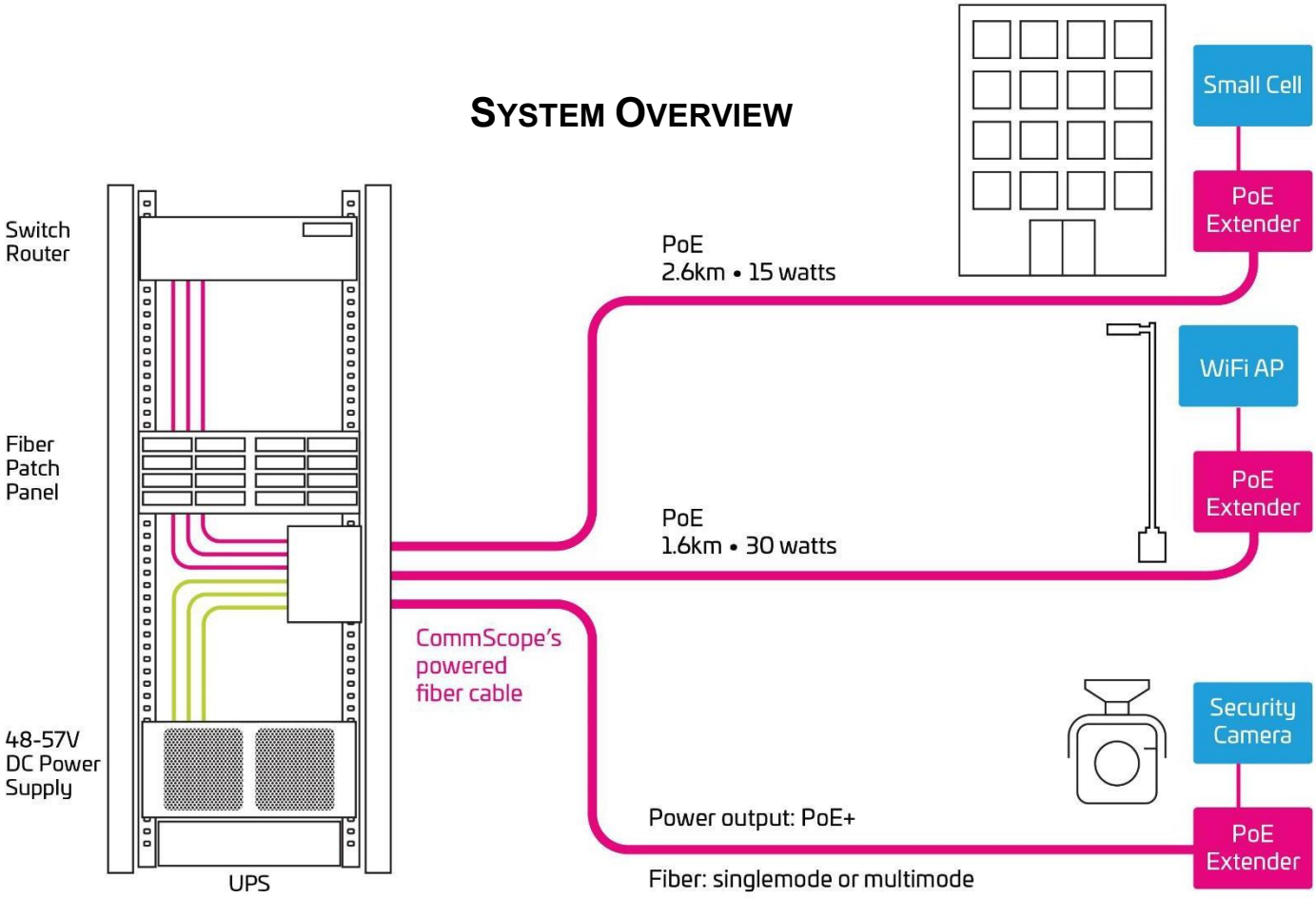


FIGURE 1 – EXAMPLE OF COUPLING COILS

SYSTEM OVERVIEW



APPLICATION DIAGRAM

END OF SECTION 27 15 15

SECTION 27 15 43

COMMUNICATIONS FACEPLATES AND CONNECTORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provides specifications for horizontal workstation cable termination components and outlet housing component. Includes wall-mount, floor-mount, and ceiling-mount components to support the various workstation outlets throughout the cabling plant.

B. Copper Category 6a Connectors UTP

C. Multi-Mode Anaerobic connectors

D. Single-Mode Optical Fiber Pigtail Connector Assemblies/Splice-On Connectors

E. Outlet Housing Components (faceplates etc.)

1.02 RELATED DOCUMENTS

A. Section 27 05 00 and all divisions of the specification and general provisions of the Construction Documents.

B. Architectural, mechanical, electrical, and all technology drawings.

C. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment

1.03 CLOSEOUT SUBMITTALS

A. As-Built Drawings:
   1. Submit all as-built drawings in accordance with the general requirements of the construction documents.
   2. Submit as-built drawings a minimum of two (2) weeks after completion of all Division- 27 work for A/E and Owner reference:

1.04 QUALITY ASSURANCE

A. Qualifications – Manufacturer
   1. Component manufactures shall be ISO 9001:2000 and offer products that are RoHS compliant.

B. Qualifications – Installer:
   1. At a minimum, seventy-five percent (75%) of the onsite contractor provided field technicians shall be factory certified within 12 months by the manufacturer of the selected telecommunications system components being installed. Proof of certification shall be available on site for review at all times for each field technician.

PART 2 PRODUCTS

2.01 COPPER UTP CONNECTORS

A. Basis-of-Design Product: Subject to compliance with requirements:
   1. Berktek/Leviton
   2. Commscope.
   3. Or approved equal

B. Product Options:
   1. The manufacturers noted above shall be the only manufacturers acceptable to the Owner and A/E.

C. Description:
   1. All UTP/STP connectors shall be rated to perform at or above current TIA/EIA performance parameters of the UTP cabling it is terminating within the communications system.
   2. All UTP/STP connectors shall have an eight (8) position, eight (8)-conductor module that accepts RJ-45 plugs.

3. When utilized as part of a channel or permanent link, all high performance modular outlet connectors shall not decrease the horizontal cable elevated performance transmission requirements before and after installation as specified in ANSI/TIA/EIA 568-C Commercial Building Telecommunications Cabling Standard (horizontal cable section) in all noted performance parameters.

D. Accessory Products:
1. Provide any accessory products related to the UTP connectors required to provide a complete and functional infrastructure system.
2. Port RJ-45 jack block out device to safely secure access to unused ports and deter vandalism to jacks.
3. Provide complete with all required mounting hardware and fittings and cables needed.

2.02 SINGLE MODE OPTICAL FIBER PIGTAIL CONNECTORS ASSEMBLIES

A. Manufacturer List:
1. Corning

B. Product Options:
1. The manufacturers noted above shall be the only manufacturers acceptable to the Owner and A/E.

C. Description:
1. Single mode Optical fiber pigtail connector assemblies housed in manufacturers connector panels.
2. FuseLite Splice on Connector is acceptable.
3. Duplex LC style connectors.
4. Maximum insertion loss across mated pair shall be less than 0.3 dB, tested per FOTP-171 Method A. Typical Insertion loss should be maximum of 0.15 dB. Minimum return loss shall be less than 60.5 dB, tested per FOTP-171. Typical return loss should be 60 dB.
5. Pigtails shall have minimum 2 meters of attached cordage.
6. Pigtails shall be assembled and tested by the connector manufacturer.

D. Accessory Products:
1. Provide any accessory products and tool kits related to the termination of the optical fiber connectors to provide a complete and functional infrastructure system.

2.03 MULTIMODE OPTICAL FIBER CONNECTORS (FIELD TERMINATE)

A. Manufacturer List:
1. Corning:
a. Anaerobic adhesive connector

B. Product Options:
1. The manufacturers noted above shall be the only manufacturers acceptable to the Owner and A/E.

C. Description:
1. All indoor multimode optical fiber connectors shall be OM4 LC-type connectors, rated and approved by the manufacturer to perform at the level designated by the optical fiber strands being terminated. Each connector shall allow rapid termination of inter- building, intra-building, and horizontal indoor optical fiber cables.
2. The connector shall be field installable type and contain a mechanical splice.
3. Connector shall have a fiber stub in the ceramic connector ferrule that is bonded in the ferrule micro-hole, the connector shall not require end face polishing in the field.
4. When tested in accordance with FOTP-171, the connector shall be consistently capable of insertion losses 0.1 dB (typical) and shall be 0.5 dB (maximum) when installed in accordance with the manufacturers recommended procedure.

D. Accessory Products:
1. Provide any accessory products and tool kits related to the termination of the optical fiber connectors to provide a complete and functional infrastructure system.

2.04 OUTLET HOUSING COMPONENTS

A. Manufacturer List:
   1. Berktek/Leviton.
   2. Commscope.

B. Product Options:
   1. The manufacturers noted above shall be the only manufacturers acceptable to the Owner and A/E.

C. Description:
   1. All outlet housings at the various technology outlet locations shall provide the designated number modular insert ports as indicated in the drawings.
   2. All flush-mounted faceplates shall be provided per the port configurations shown on the telecom drawings.
   3. Faceplates for wall-mounted phones shall be one (1) port single gang faceplates that have wall-mount lugs allowing vertical phone mounting.
   4. Faceplates for flush floor mounted outlets shall be coordinated with the floor box or poke thru device that will be selected and installed outside the scope of this section.
   5. System furniture faceplates shall be capable of fitting in the furniture system selected by the Owner. Furniture faceplates shall be provided per the port configurations shown on the telecom drawings. Furniture faceplate extenders shall be used (if required) to maintain proper bend radii within the furniture raceway/pathway.
   6. Surface mounted boxes shall be capable of the quantity of outlet jack requirements at each outlet locations indicted in the drawings.
   7. All outlet-housings shall provide a clear TIA/EIA 606-A labeling location for both the individual outlet port and the entire outlet housing location, unless otherwise indicated in the project drawings.

D. Accessory Products:
   1. Provide any accessory products related to the workstation outlet housing components required to provide a complete and functional infrastructure system.

PART 3 EXECUTION

3.01 EXAMINATION

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section. Examples of work which must be checked include, but are not limited to:
   1. Electrical requirements (conduit installation and capacity)
   2. The telecommunications rooms are the size shown on the project drawings.
   3. Adequate clearances of doors, riser spaces and ceilings for all component of the telecommunications system.
   4. Examine and compare the telecommunications drawings and specifications with the drawings and specifications of other trades. Report any discrepancies between them to the A/E and obtain written instructions for changes or revisions.

3.02 INSTALLATION

A. Process:
   1. Install all connectors and couplers under the guidelines of the manufacturers' recommended instructions and per all TIA/EIA 568C standards, BICSI guidelines, and manufacturer approved industry practices.
   2. The installation and performance parameters of all installed couplers and connectors shall be verified by the trade contractor through TIA/EIA 568C testing procedures.
   3. Color of all outlet housing components shall be coordinated with the Owner before purchase and installation.
   4. All technology outlets located on walls shall be flush mounted, level and plumb.

5. All technology outlets shall be mounted at right angles and parallel to the floor, unless installation requirements or design dictate otherwise.
6. Install blank inserts in outlet housing spaces that are not being filled with cable termination modules. Blank inserts shall match the workstation housing color, unless otherwise indicated in the drawings.
7. All outlets located in systems furniture may be served from a wall adjacent to the furniture cluster or a floor box. If the cable is exposed prior to entering furniture raceway, install spiral wrap tubing to protect the cable per the manufacturer's recommendations.
8. All outlet housings as well as each individual utilized port must be labeled in accordance with the Owner-approved labeling scheme.

3.03 RE-INSTALLATION

A. No additional burden to the owner regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components. Scheduling for re-installation work shall be coordinated, in writing, with the owner prior to beginning any re-installation work

3.04 CLOSEOUT ACTIVITIES

A. Contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the Owner and A/E team.

B. Contractor to submit all as-built drawings and any test documentation required prior to acceptance by the Owner

END OF SECTION 27 15 43

SECTION 27 16 19

COMMUNICATION PATCH CORDS, STATION CORDS, AND CROSS CONNECT WIRE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provides specifications for Category 6a and optical fiber horizontal cable patching to distribute network signals.

B. Copper Category 6a Patch Cords UTP.

C. Optical Fiber Patch Cords.

1.02 RELATED DOCUMENTS

A. Section 27 05 00 and all divisions of the specification and general provisions of the Construction Documents.

B. Architectural, mechanical, electrical, and all technology drawings.

C. Refer to Structural Seismic Requirement design documents Specifications, if available, for Non-Structural Components for all structural bracing and support of telecommunications equipment.

1.03 CLOSEOUT SUBMITTALS

A. As-Built Drawings:
   1. Submit all as-built drawings in accordance with the general requirements of the construction documents.
   2. Submit as-built drawings a minimum of two (2) weeks after completion of all Division- 27 work for A/E and Contracting Agency reference:

1.04 QUALITY ASSURANCE

A. Qualifications – Manufacturer
   1. Component manufactures shall be ISO 9001:2000 and offer products that are RoHS compliant.

B. Qualifications – Installer:
   1. At a minimum, seventy-five percent (75%) of the onsite contractor provided field technicians shall be factory certified within 12 months by the manufacturer of the selected telecommunications system components being installed. Proof of certification shall be available on site for review at all times for each field technician.

PART 2 PRODUCTS

2.01 COPPER UTP/STP PATCH CORDS

A. Basis-of-Design Product: Subject to compliance with requirements:
   1. Berktek/Leviton.
   2. Commscope.

B. Product Options:
   1. The indicated manufacturers shall be the basis of the design and each assembly selected shall address the particular infrastructure requirements.

C. Description:
   1. Category UTP Copper patch cords for equipment patching (RJ-45 to RJ-45 Cords): Modular RJ45 male plug connector's equipped with (8) eight gold anodized pins shall be factory terminated at each end of the patch cords. Modular plug connectors will be snag free in design or will utilize a molded plastic boot to cover the modular plug tab. Category 6 UTP cords shall be 26 AWG.
   2. All patch cords shall conform to the requirements of the EIA/TIA 568C.2 standard performance parameters and shall also guarantee headroom margin above the minimum EIA/TIA 568C standard NEXT and PSNEXT requirements; and shall provide positive ACR to 5000 MHz-km as part of the connectivity system.
   3. All copper UTP patch cords shall have stranded conductors that match the EIA/TIA 568-C performance characteristics of the category cable specified.

4. Patch cord performance levels shall be equal to or greater than the performance level of the installed UTP cabling system.
5. All copper patch cord lengths for patching inside the telecom rooms are to be provided appropriate to patching from network equipment ports to the copper patch panels ports within the Data Center and IDF.

D. Accessory Products:
1. Provide any accessory products related to the UTP/STP connectors required to provide a complete and functional infrastructure system.
2. Port RJ-45 patch cord lock-in device to safely secure access to patched cords and deter accidental removal to network connection.
3. Provide complete with all required mounting hardware and fittings and cables needed.

2.02 OPTICAL FIBER PATCH CORDS

A. Basis-of-Design Product: Subject to compliance with requirements:
1. Corning.

B. Product Options:
1. The indicated manufacturers shall be the basis of the design and each assembly selected shall address the particular infrastructure requirements.

C. Description:
1. All optical fiber patch cords shall conform to the requirements of the EIA/TIA 568C.3- 1 standard performance parameters for the multimode or single-mode optical fiber and shall have the same manufacturer, cable type, connector and polish as noted for the backbone fiber.
2. All optical patch cords shall have push-pull strain relief boot and duplex clip.
3. All optical fiber patch cord lengths are to be provided appropriate to patching from network equipment ports to the optical fiber patch panels ports within the Data Center and IDF.
4. It is the responsibility of the contractor to verify lengths and counts of optical fiber patch cords with the Contracting Agency prior to purchase.
5. All single-mode patch cord colors are to be industry standard yellow and provided in a duplex configuration.
6. All multi-mode patch cord colors are to be industry standard aqua and provided in a duplex configuration.
7. Any optical fiber patch cords purchased without written authorization by the Contracting Agency are purchased at the contractor’s own risk.

D. Accessory Products:
1. Provide any accessory products related to the optical fiber connectors required to provide a complete and functional infrastructure system.

PART 3 EXECUTION

3.01 EXAMINATION

A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section. Examples of work which must be checked include, but are not limited to:
1. Electrical requirements (conduit installation and capacity)
2. The telecommunications rooms are the size shown on the project drawings.
3. Adequate clearances of doors, riser spaces and ceilings for all component of the telecommunications system.
4. Examine and compare the telecommunications drawings and specifications with the drawings and specifications of other trades. Report any discrepancies between them to the A/E and obtain written instructions for changes or revisions.

3.02 INSTALLATION

A. Process:
   1. Install all horizontal cable per the manufacturer's recommended installation instructions, under the guidelines of TIA/EIA 568 C and BICSI.
   2. Category 6 equipment Patch cords: Provide (2) copper patch cords (one for each end of the cable termination) for every Category cable installed.
   3. Fiber Optic Equipment Patch cords: Provide (2) fiber optic LC duplex patch cords (one for each end of fiber termination) for every pair of fiber strands installed.
   4. All patch cord lengths are to be provided appropriate to patch from rack mounted network equipment ports to the rack mounted horizontal station outlet patch panel ports within the Data Center/IDF and from the workstation outlet to the computer/or other IP end device NIC card/RJ45 port.
   5. Provide new, sealed patch cords in lengths, colors and counts approved in writing by the Contracting Agency.
   6. It will be the responsibility of the communication contractor to provide install all Category 6 and Fiber patch cords per direction and coordination of Contracting Agency IT dept.

3.03 RE-INSTALLATION

A. No additional burden to the Contracting Agency regarding costs, network down-time, and end user interruption shall result from the re-installation of specified components. Scheduling for re-installation work shall be coordinated, in writing, with the Contracting Agency prior to beginning any re- installation work.

3.04 CLOSEOUT ACTIVITIES

A. Contractor shall provide documentation of all telecommunications system components under this section utilized throughout the site for review and reference by the Contracting Agency and A/E team.

B. Contractor to submit all as-built drawings and any test documentation required prior to acceptance by the Contracting Agency.

END OF SECTION 27 16 19

This page intentionally left blank

SECTION 28 05 00

COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Related Documents
B. Summary and related sections
C. References
D. Definitions
E. System Description and General Responsibilities
F. Coordination
G. Quality Assurance
H. Submittals
I. Delivery, Storage, and Handling
J. Site Conditions
K. Sequencing and Scheduling
L. Warranty
M. Extra Materials
N. Product Options and Substitutions
O. Materials and Equipment
P. Equipment Modification
Q. Fabrication
R. Source Quality Control
S. Firestopping/Sealant Materials
T. Examination
U. Installation
V. Field Quality Control
W. Cleaning
X. Training

1.02 RELATED REQUIREMENTS

A. Section 28 13 00 “Physical Access Control System.”
B. Section 28 16 00 “Intrusion Detection System.”
C. Section 28 23 00 “Video Surveillance System.”

1.03 REFERENCES

A. Codes compliance - Comply with the established project edition of the following codes as applicable:
   1. National Fire Alarm Codes (NFPA 72) NFAC
   2. All Local, State, County or Federal codes and ordinances
B. Standards Compliance - Comply with the following standards as applicable:
   1. American National Standards Institute ANSI
   2. American Society for Testing and Materials ASTM
   3. Electronics Industry Association EIA
   4. Electrical Testing Laboratories ETL
   5. Federal Communications Commission FCC
   6. Institute of Elect. and Electronics Engineers IEEE

7.	National Electrical Contractors Association	NECA
8.	National Electrical Manufacturers Association	NEMA
9.	National Fire Protection Association	NFPA
10.	Occupational Safety Health Act	OSHA
11.	Underwriter's Laboratories	UL

1.04 DEFINITIONS

A. By Others or By Other Trades: By persons or parties other than the Division 28 Contractor. In this context the words “by others or by other trades” shall not be interpreted to mean “not in contract (NIC)”.

B. Certified: Equipment has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards and found to be safe for use in a specified manner; production is periodically inspected by a nationally recognized testing laboratory; and it bears a label, tag, or other record of certification.

C. Concealed: Not visible or readily accessible such as, embedded in masonry or other construction installed behind wall furring with double partitions or above hung ceilings, in crawl spaces, in shafts.

D. Conveniently Accessible: Capable of being serviced without climbing or crawling under or over obstacles, and with adequate working clearance both front and back.

E. Damage: Visible or invisible abuse that negatively affects performance or appearance and creates defective materials or workmanship.

F. Defective Materials or Workmanship: Operational failures, performance below minimum requirements, evidence that the system will not be reasonably maintainable, errors in documentation, abnormal operations, unsafe conditions, or similar unsatisfactory performance.

G. Contractor: Company holding the contract or agreement with the Contracting Agency or its representative. The Contractor may, when permitted, sub-contract Work described in this Section to which the term contractor may apply.

H. Exposed: Not concealed.

I. Failure: Any deviation from intended system operation and performance, as determined by the Contract Documents and subsequent submittals and the Contracting Agency.

J. Furnish: Purchase and deliver to the Project site complete with every necessary appurtenance, support, and accessory required for operation.

K. Install: Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the Project.

L. Labeled: Equipment embodies a valid label, symbol, or other identifying maker of a nationally recognized testing laboratory such as Underwriters’ Laboratories, Inc., the laboratory makes periodic inspections of the production of such equipment, and the labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.

M. Listed: Equipment is mentioned in a list which is published by a nationally recognized laboratory which makes periodic inspection of the production of such equipment or states that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.

N. Nationally Recognized Testing Laboratory: A testing laboratory, which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

O. Provide: Furnish and install, completely ready for use, including all accessories required for operation.

1.05 SYSTEM DESCRIPTION AND GENERAL RESPONSIBILITIES

A. The work to be performed under this contract includes the furnishing of all labor, materials, and equipment for a video surveillance system, a physical access control system, and an intrusion

detection system. Work shall include all provisions of new electronics controls systems, including, physical access control, video surveillance, and intrusion detection.

B. Combined Prescriptive and Performance Design Requirements
   1. Division 28 includes a combination of prescriptive and performance specifications. Compliance with the performance specifications, as well as coordination and integration of the prescription requirements, will require substantial design work on the part of the Contractor.
   2. The performance requirements are intended to establish overall system performance requirements, satisfy the operational requirements, and establish the inter-coordination requirements for the Division 28 systems.
   3. The prescriptive requirements establish the minimum quality, characteristics, and types of components, equipment, and materials to be used to achieve the stated system performance requirements. The Contractor is advised, however, that prescriptive specifications have not been provided to satisfy all of the specified performance requirements.
   4. The Contractor shall carefully consider all of the requirements for each of the Division 28 systems when preparing its bid. Any questions regarding the intent of these requirements, the scope of the systems or their coordination requirements must be submitted in writing prior to bidding in accordance with the Instructions to Bidders. The Contractor shall have no claim for either extra compensation or extra time on the grounds that it did not understand the scope or the requirements of the Division 28 work, and/or the coordination requirements of the Division 28 work with the work of the other Divisions.
   5. Compliance with the project requirements will be progressively monitored and adjusted through the submittal process, installation period, and performance verification testing.

C. Drawing Interpretation
   1. The Drawings are diagrammatic and indicate the general arrangement of systems and equipment unless indicated otherwise by dimensions or detail drawings. The Drawings installation and schematic diagrams and symbols to outline the Work to be provided. These drawings do not have any dimensional significance, nor do they delineate every item required for the intended Work. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete Work are excluded.
   2. The Work shall be provided in accordance with the intent expressed on the Drawings and Specifications, and in conformance with the actual building architectural and structural conditions. When in conflict, field conditions take precedence over the Contract Documents.
   3. The meaning of abbreviations shall be the same whether in lower case letters or without periods.
   4. The use of words in the singular shall not be considered as singular where other indications denote that more than one item is referred to.
   5. Details that appear on the Contract Documents which are specific with regard to the dimensioning and positioning of the Work, are intended only for the purpose of establishing general feasibility. They do not replace engineering or field coordination by the contractor for the Work.

D. Provide all parts and equipment for a complete and operational system for the Work of Division 28 as described herein and shown on the drawings.

E. Furnish and install all trenching and backfill, duct banks, conduits, raceways, sleeves, boxes, gutters, shelves, enclosures, shelf and enclosure supports, backboards, pull ropes (in unused or spare conduits) required to make all systems fully operational, including components not shown on the Drawings, but necessary for fully operational systems.

F. Furnish, install, terminate, test, dress, and identify all wire and cable required to make systems fully operational, including all wire and cabling not shown on the Drawings, but necessary for fully operational systems.

G. Recognize that the Work entails integration between individual systems, as well as the design and implementation of many system and component interfaces. Take full responsibility for the complete design, installation, and performance of the total integrated system, including integration between systems and various interfaces, to achieve the specified operational features and system performance requirements.

H. Fully test the systems, demonstrate their satisfactory operation, and train maintenance and operating personnel, as specified in this Section and the Sections governed by this Section.

1.06 COORDINATION

A. Coordinate with the Contracting Agency and all other trades as required to ensure that the entire Work of this Project will be carried out in an orderly, complete, and coordinated fashion.

B. Coordinate installation of lighting and ventilation in all equipment rooms and control stations to avoid any possible interference and to enhance system function.

C. Coordinate with the Work of all applicable Divisions and Drawings for the required electrical and mechanical control interfaces to the work of this section.

D. If applicable, provide coordination drawings of security device plate mounting templates and internal frame conduits to the hollow metal frame manufacturer/supplier to facilitate frame preparation for electronic devices. Rework all frames for which device mounting has not been coordinated at Contractor's expenses.

E. If applicable, obtain product data and wiring schematic information from the Division 8 and 11 Contractors/manufacturers for all approved locking and door monitoring hardware. Coordinate with the Contractors to properly wire, terminate and test all electrically controlled and monitored door/gate hardware.

1.07 QUALITY ASSURANCE

A. Division 28 requires contractors with similar work experience and specific licenses and certifications to perform the work of this section. Contractors must be certified or licensed at the time of bid where Manufacture certification or licensure is required. Required licenses and certifications shall be submitted the contractor's bid package.

B. The Division 28 contractor shall have had experience in the design and installation of similar systems of similar project sizes and similar integration as this project to be considered qualified.

C. The Contractor shall be responsible for all costs incurred including costs incurred by the Contracting Agency and its representatives for failure to provide the experience and key personnel as specified.
   1. Deductive change orders may be issued as a result of the failure to properly engineer the work prior to construction or improperly installed work that results in costs incurred to the Contracting Agency. Examples of incurred costs are rejection of submittals for failure to follow specifications or failure to properly engineer the work; re-inspection of rejected work.

D. The Division 28 contractor shall maintain a local service center with qualified service technicians for the duration of the Warranty.

E. The Division 28 Contractor shall have an active C-7 or C-10 contractor's license, as required by the project scope, issued by the State of California.

F. Key Project Personnel must have work experience with projects of similar size and complexity. Systems experience shall be demonstrated for the Key Project Personnel. R sum s of prospective key personal shall be submitted within 30 days of contract award.
   1. Project Manager Qualifications
      a. Five years' experience with projects of similar size and complexity.
   2. The approved Project Manager shall represent the Contractor at all times in all project matters and shall be responsible for the administrative work including but not limited to, the following:
      a. Representation at all project meetings.
      b. Progress schedule and progress reporting.

c. Payment schedule of values and pay requests.
d. Representation and management of all employees and sub-contractors.
e. Conduction of on-site performance and acceptance testing.

3. The approved Project Engineer shall be qualified and shall be responsible for technical work including but not limited to, the following:
   a. Preparation and signature of all engineering, shop drawings, and product data submittals.
   b. System fabrication, field installation work, and testing.
4. Consider all qualification and experience materials submitted as binding. Obtain the Contracting Agency's approval in writing prior to any deviations from the minimum requirements in organization, personnel, work plan, quality control plan, procurement plan or other declaration within the qualification submittal. Key project personnel substituted prior to or during the Work must meet the specification requirements and obtain the Contracting Agency's approval.

G. Regulatory Requirements and Standards:
1. Obtain and pay for all permits and inspections required by all legal authorities and agencies having jurisdiction for the Work. The certificates of all such permits and inspections shall be delivered to the Contracting Agency.

1.08 SUBMITTALS

A. Submit under provisions of Section 1-06.

B. Contractor is advised that approval or acceptance of product data or shop drawing submittals does not release the contractor from providing all necessary documentation per submittal requirements, nor does it obviate contractor from additional design and coordination throughout the project.

C. Work Plan
1. Submit a work plan for all work to be performed in the existing facility within 15 days of the Notice to Proceed.

D. CPM Schedule
1. Submit a Critical Path Method Schedule within 30 days of the Notice to Proceed.
2. At a minimum show tasks by area such as by building, by floor or other appropriate designations.
3. Include tasks that are not part of the work of this section but that may affect this section such as work by other trades or contractors or Contracting Agency review time.
4. Include tasks that are not part of the work of this section but that may affect this section such as work by other trades or contractors or Contracting Agency review time.

E. Submittal Matrix
1. Prepare a matrix of submittals by type vs. section of all submittals to be made by the Division 28 contractor within 30 days of the Notice to Proceed.
2. Utilize the list of required submittals listed at the end of this section as a starting point. Add columns for expected delivery dates and each specification section. If a listed submittal is not required for a specific section, indicate such with an "N/A" or other means in the column and row cross point.

F. Schedule of Values
1. Submit a Schedule of Values (SOV) based on the CPM schedule and Submittal Matrix that reflect the value of the systems and installation of work for this Division.
2. That approved SOV will be used as a basis for progress payments.

G. Product Data:
1. Product data is required for all materials and equipment. Include complete bill of materials for each section with the product data submittal.
2. Cross-reference submitted items to the Specifications using their related sections and paragraph numbers.

3. Submit complete product data for all system components in a single, bound submittal of one or more volumes. Provide a table of contents and labeled divider tabs for each section. Partial submittals for individual sections will be returned without review.
4. Include descriptive literature, catalog cuts, illustrations, schematics, technical data sheets, and test data necessary for the Contracting Agency to ascertain that proposed equipment and materials comply with specification requirements. Include manufacturer's name, model, catalog or part numbers. Catalog cuts shall be legible and shall clearly identify equipment being submitted.
5. Include required calculations, I/O points lists, system zone schedules, and other tabular data as necessary to clarify system sizing and configuration. Do not, however, consider such submittals as a substitute for complete shop drawings.
6. Disclosure of Product Deviations: Specifically identify and tabulate any and all deviations from the contract documents including all system functions and features. Reference the corresponding specification sections and paragraph/article numbers. All variances and deviations will be reviewed for acceptance or rejection. It will be the Contractor's sole responsibilities to comply with all other contract requirements not revealed in the disclosure of product deviations.

H. Shop Drawings:
1. Shop drawings are required for all systems and component assemblies.
2. AutoCAD ".dwg" files of the Contract Drawings may be made available upon request. These files may be used as a first step in the preparation of shop drawings. Do not consider the drawing plots from such files as a substitute for the shop drawings that are to be prepared by the contractor.
3. Shop drawings will not be accepted or considered unless they are submitted as a complete package for each specification section. Partial submittals covering less than a whole system or with incomplete interfaces to other systems will be rejected.
4. Standard manufacturer's drawings may not be used as shop drawings unless specifically modified for use on this project.
5. Each drawing requires a unique drawing number and revision level. Revisions shall per be dated and referenced per submittal number. Delta numbers and clouds on the drawings shall be used in all instances where changes have been made to the pervious submittal.
6. At a minimum, include the following shop drawings:
    a. Floor Plans: Scaled drawings showing equipment and device locations in plan view. Include wire and cable types and quantities, raceway sizing and routing. Routing information shall indicate where rated assemblies are penetrated. Separate into as many plan series as needed to prevent overlapping information. These drawings shall be fully coordinated with other trades prior to submittal. Show relationships to adjacent surrounding structures.
    b. Equipment and Control Room Plans and Elevations: Scaled, dimensioned drawings showing security equipment layouts in security equipment rooms, electrical/security closets, and control rooms. Include electrical J-boxes and receptacles, power, conduit sizing and routing, metal gutters, wiring ducts, cable trays, and supports. Indicate all other non-security cabinets, enclosures, and equipment within the room. All constraints and clearance requirements shall be shown in dimensioned drawings.
    c. Cabinet, Enclosure, and Rack Elevations: Scaled, dimensioned drawings for each system equipment cabinet, enclosure, and rack showing component and equipment mounting, wire and cable routing and separation, connector and terminal block locations and labeling, and all necessary fabrication details.
    d. System Block Diagrams: Single line block diagrams showing the general relationship between system components and the interconnection between systems. Use these drawings as a reference for the Single line diagrams and point-to-point diagrams by cross-referencing the shop drawing number of those diagrams on these drawings.
    e. Single Line Diagrams: Interconnection diagrams for the riser and trunk wiring between equipment cabinets, enclosures racks and major components. Use the same equipment designations as the floor plans and block diagrams.

f. Point-to-Point Diagrams: Drawings which show the wiring of each component or device of each individual system. Include details of power supply, grounding, shielding, shield grounding, surge protection, fusing, connector pin-outs, terminal assignments, and similar wiring and connection details. Use the same component and device designations as the floor plans and other shop drawings.
g. Device Installation Diagrams: Details which show the installation and wiring termination of each field device in each individual system. Include settings for dipswitches, jumpers, addresses, port assignments, etc. of all devices.
h. All other shop drawings necessary to install, fabricate, locate, identify, test, service, and repair the systems provided.

7. Shop drawings approved by the Contracting Agency OR by the Consultant Engineer is not a release from Contract requirements as defined by the Drawings, Specifications, and governing codes and regulations.

I. Samples:
1. Field Samples:
a. Wires and Cables: Submit a one (1) foot sample length of each wire and cable type to be used with the cable identification clearly shown.
b. Submit all required samples along with the product data submittal for review and approval prior to installation.
c. If all wire samples cannot be submitted at the same time, submit samples with a complete list of all cables to be used noting samples which have been submitted. Update the list with each subsequent sample submittal.
2. Devices/Equipment:
a. If required by Contracting Agency, submit sample assemblies of each of the following devices or equipment along with the product data submittal for review and approval by the Contracting Agency:
1) Substituted products if requested by Contracting Agency.
2) Custom component, board, equipment or assembly.
3. Disposition: Submitted samples become property of the Contracting Agency and will not be returned.
4. Approval of any custom or modified assemblies shall be required. Submit technical information with samples.

J. Test Procedures:
1. Initial Performance Testing: Submit test procedures, forms, and checklists for point-by-point testing. Include a listing for each individual system, each control station and control panel, each equipment room, and each major system component. At a minimum, forms shall include columns for operational/non-operational status, remarks, workmanship, and date corrected. Submit a sample format for approval by the Contracting Agency a minimum of 20 days prior to testing.
2. Performance Verification Testing: Submit test forms which are identical to or similar to the accepted Initial Performance Testing forms. Obtain approval from the Contracting Agency for any changes in test procedure or forms.

K. Test Results:
1. Performance Verification Testing: Submit completed test results prior to or with the request to have the project declared substantially complete by the Contracting Agency.

L. Record (As-Built) Documents:
1. Maintain a current record set of as-built drawings on the job and as construction and installation progress, show the actual installed location of all items, material, and equipment.
2. Accurately record actual routing of all conduits including sizes and types.
3. The as-built drawings shall be available to the Contracting Agency for review and will be required for evaluation of progress payments.

4. Submit as-built shop drawings created from the approved shop drawings and updated from the site as-built drawing set and any other drawings required to depict the as-built conditions of the installed work.

M. Operational Manuals:
1. Submit the required quantity of identical manuals, which shall contain the Theory of Operation, start up, shut down and emergency procedures, and the manufacturer's operating instructions.
2. Subdivide the manual by section with tab dividers. Provide a table of contents which identifies each section and the contents therein.
3. Submit an electronic copy.

N. Maintenance Manuals:
1. Submit a complete set of maintenance documents as described in this Section. For documents of sizes greater than 11 x 17 inches, prints and electronic copy shall be furnished.
2. Manuals shall include the following as a minimum requirement:
   a. Technical system description.
   b. System schematics.
   c. Detailed wiring diagrams to identify cabling, termination, and routing.
   d. Panel assembly drawings to identify location of components, terminal strips, and equipment as required to correlate with system drawings.
   e. Descriptions and drawings as required to maintain equipment from the board to the component level.
   f. Description of software and user programmable functions. Procedures for user programmable functions shall be included.
   g. A complete electronic copy of each unique system program.
3. For systems where the program resides on electronic media or other similar storage medium, furnish a copy of the media, or similar medium, to the Contracting Agency.
4. Where multiple systems are combined into a single integrated system, documentation shall include a description of the integrated system and the details of the interfaces between systems.
5. Provide a list of current telephone numbers and addresses of all material vendors and equipment manufacturers who have supplied components in this Project. Include separate service telephone list and purchasing telephone list cross-referencing with each component.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect all materials and equipment from damage during storage at the site and throughout the construction period. Protect equipment and materials during shipment and storage against physical damage, dirt, dust, moisture, cold, rain, and any foreign substances that may damage the equipment.

B. Prevent damage from rain, dirt, sun and ground water by storing the equipment on elevated supports and covering them on all sides with securely fastened protective rigid or flexible waterproof coverings.

C. Protect conduit by storing it on elevated supports and capping the ends with suitable closure material to prevent dirt accumulation.

D. Protect all fabricated and/or installed materials and equipment against dust, dirt, moisture, physical damage, metal debris, and any foreign substances that may damage the equipment.

E. Protect painted surfaces with removable heavy Kraft paper, sheet vinyl or equal, installed at the factory and removed prior to final inspection.
1. Replace equipment determined by the Contracting Agency to be damaged. Repaint and finish damaged paint on equipment and materials with the same quality of paint and workmanship used by manufacturer so that repaired areas are not obvious.

1.10 SITE CONDITIONS

A. Site Investigation
   1. Prior to commencement of work, the Contractor shall perform a site survey of all related existing systems and submit any potential problems of the design documents that may increase the installation cost of the project.
   2. Survey all locations where work is to be performed and verify existing conditions prior to shop drawing submittals.

B. Coordination with Security Personnel
   1. The Contracting Agency will assign a contact person for the contractor to coordinate day to day activities and access into areas. Coordinate all system interruptions and scheduled down time with the contact person.

C. Security Requirements
   1. Any special security requirements will be provided by the Contracting Agency. .

1.11 SEQUENCING AND SCHEDULING

A. General Requirements:
   1. Do not begin the project without the Contracting Agency's acceptance of proposed key project personnel for the Division 28 Work.
   2. Prepare, review, and coordinate with the Contracting Agency an approved construction (CPM) work schedule. Schedule work in areas and at times that will not interfere with scheduled activities as defined by the Contracting Agency.
   3. Provide weekly short term (4-week schedule) updates to Contracting Agency showing day to day progress and impact to occupied areas.
   4. Do not procure any equipment without accepted product data submittals. Do not perform any field installation without accepted shop drawings. Do not begin any extensive software development or programming without accepted system, operational narratives, the required Contracting Agency's coordination, and user's requirements.
   5. Pre-assemble control electronics, control panels, racks, and cabinets off-site as most practical.
   6. Install system control equipment, control panels, cabinets, racks, and consoles only after major construction in the area in which they are to be installed has been completed and areas have been cleaned, painted, and sealed.
   7. After systems installation and prior to point-by-point performance testing, thoroughly pre-test all devices and device wiring for proper performance. Then, thoroughly pre-test each system function in each state or condition under every operating mode.

B. Coordinate all work in the existing facility with the facility contact person.

1.12 WARRANTY

A. The Contractor is to provide a warranty of the work provided under this contract (including, but not limited to, software, hardware, and peripheral equipment) as a system, including interfaces to work by others for one year from the date of Acceptance of the Work. Specific Division 28 sections may require longer warranty periods. Divisions of work among various suppliers, vendors, installers, subcontractors, and other parties will not be recognized or accepted.

B. Extended Warranty: Provide itemized pricing for an Extended Service and Warranty for years 1, 2, and 3 after the initial warranty period. Describe whether all parts and labor are included in this offering.

C. Guarantee to repair and replace defective materials or workmanship during the warranty period including labor and materials.

D. An emergency maintenance (Warranty) request shall be defined as a system or portion of a system failure that affects building safety, security, and operation of critical components, including any access-controlled door, which by failing, prevents entry into a building space through other means or direction. Failure of a single component (i.e., access-controlled door

which does not prevent access to a space through other means or direction, camera, or monitor) is not considered an emergency maintenance request.

E. Respond within four hours to an emergency maintenance request. Provide a twenty-four-hour telephone contact number (24 hours per day, 365 days per year). Service response time is defined as the period between the placing of a service request and the arrival of a qualified technician capable servicing the problem on-site.

F. Maintain a sufficient parts inventory within 50 miles of the project during the warranty period to meet the guaranteed system repair times.

G. Repair and make operational any defective materials or workmanship resulting from an emergency maintenance request within an 8-hour period from the time of the initial arrival of service personnel at the site. Correct non-emergency defective materials or workmanship within four (4) calendar days of receiving notice of the defect.

H. Where the equipment manufacturer's warranty covers a longer time period than that required by these Specifications, the manufacturer's warranty shall govern.

1.13 EXTRA MATERIALS

A. Prior to Acceptance of the Work, deliver to the Contracting Agency all spare parts and extra materials required in each Section. All spare parts and extra materials shall be brand new in their original shipping boxes or packages and shall have one year material warranty remaining at the time of delivery. Extra materials shall be available to the Contractor to use as immediate replacements during the warranty period. All extra materials used for the warranty requirements shall be replaced by the Contractor.

B. Special Tools:
   1. Provide three of each type of security screw bits used.
   2. Provide minimum of one of any specialty tools used.

PART 2 PRODUCTS

2.01 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Comply with the General and Supplementary Conditions and Section 1-06.7.

B. The products named in this section and the sections governed by this section establish minimum qualities that substitutions must meet to be considered acceptable. The specified products have also been used in preparing the drawings and specifications, and therefore establish the basis for equipment sizing, wire and cable design, power consumption, and other design parameters.

C. Substitution requests, if permitted, will be considered only if submitted in strict accordance with the followings:
   1. Cross-reference submitted items to the Specifications using their related Section and paragraph number.
   2. Submit complete product data, descriptive literature, catalog cuts, illustrations, schematics, technical data sheets, and test data necessary for the Contracting Agency to ascertain that proposed equipment and materials comply with specification requirements. Include manufacturer’s name, model, catalog or part numbers. Catalog cuts shall be legible and shall clearly identify equipment being submitted.
   3. Disclosure of Product Deviations: Specifically identify and tabulate any and all deviations from the contract documents including all system functions and features. Reference the corresponding specification sections and paragraph/article numbers. All variances and deviations will be reviewed for acceptance or rejection. It will be the Contractor’s sole responsibilities to comply with all other contract requirements not revealed in the disclosure of product deviations.

D. The Contractor shall take full responsibility for all design, coordination, and cost associated with substitutions including, but not limited to:
   1. Its integration into the total system including physical mounting space, electrical interconnection, signal wiring, power, quality, electromagnetic interference, communication protocols, and similar design considerations.
   2. Any additional materials, equipment, components, accessories, items required for equivalent system operation and performance.
   3. Any necessary changes to branch power circuits, circuit protective devices, and the Work of other trades.
   4. Any modifications to wire, cable, and raceway design.

2.02 MATERIALS AND EQUIPMENT

A. All equipment and materials required for installation under these Specifications shall be new and without blemish or defect.

B. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacturing of such items, for which replacement parts are available. Specifications are prepared long in advance of project construction; the contractor is to use the newest model of the specified products available at bid time.

C. All material and equipment shall be listed, labeled, or certified by Underwriters' Laboratories, Inc., where such standards have been established. Equipment and material which are not covered by UL Standard will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe will be considered, if inspected or tested in accordance with national industrial standards such as NEMA or ANSI.

D. All parts of a system shall be the product of one manufacturer. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer. Constituent parts which are similar shall be the product of a single manufacturer.

E. All components of an assembled unit need not be products of the same manufacturer; however, all components must be acceptable to the Contracting Agency. Components shall be compatible with each other and with the total assembly for the intended service.

2.03 EQUIPMENT MODIFICATIONS

A. When standard manufactured equipment is modified from its original condition or factory options have been exercised identify the changes as noted below.
   1. Clearly identify the modifications on the shop drawings.
   2. Clearly identify each piece of modified equipment with a label, which states, "This unit has been modified..." and identify the modification or reference. Locate the label so that a service technician or factory service personal will be able to determine the equipment in use is non-standard and that modifications are required for service, testing and replacement.
   3. Identify and describe the modifications on the Record Documents.

B. Equipment modification labels are not required for jumper or switch settings.

2.04 FABRICATION

A. Fabricate enclosures to easily accommodate interconnecting cables entering from above or below through the use of auxiliary gutters, cable trays, and conduits. Protect all metal cabinet edges where conductors cross and conduit ends with protective covering or bushing.

B. Group wires and cables by types, boards and modules, and maintain National Electrical Code clearances throughout the installation, including Class 1, Class 2, communications, and branch circuit power separations. Maintain sufficient and proper separation between microphone-level audio, line-level audio, high-level audio, and video cables.

C. Uniformly organize equipment and cable routing throughout all enclosures, racks, and cabinets. Provide wiring ducts, raceways, wire posts, D rings, wire saddles to route and secure factory

and field wiring. Provide routing for all wiring from point of entry to point of termination to maintain required separation, access to all components, and general organization to the wiring. Neatly dress, route and secure wiring.

D. Mechanically fasten cabinet raceways and cable clamps to enclosure rear panels, rack members, console members, or to other system components. The use of adhesive fasteners (without mechanical fastener) is not permitted. Furnish and install cable support posts where necessary to properly support cables.

E. No splices are permitted in cabinet raceways. Exception: Splice to cable shield when within two inches of cable termination is permitted.

F. Furnish and install metal grounding type outlet strips in each equipment cabinet, enclosure, and rack. Leave a minimum of two unused receptacles at each location for future expansion. Neatly shorten and dress power cords from individual equipment to the outlet strips.

G. Provide protection from accidental contact of all terminals or exposed conductors over 25 volts within enclosures that contain Class 2 wiring. Use non-conductive barriers, heat shrink or other acceptable methods. Tape of any kind is not permitted.

H. Provide an isolated ground bus within each equipment cabinet, enclosure, and rack for single point termination of audio and data shields and grounds.

2.05 SOURCE QUALITY CONTROL

A. Shop Inspections:
   1. The Contracting Agency shall have the right at all times to inspect or otherwise evaluate the Work performed or being performed and shall have access to the premises in which the Work is being performed.
   2. The Contracting Agency may verify the inspections or re-inspect any item. The Contracting Agency reserves the right to reject materials and workmanship found unacceptable during inspections.

B. Shop Test and Demonstration
   1. Shop Test and Demonstration shall be a major milestone that shall commence only after all shop assembly, system integration, and software development and programming is complete. Contracting Agency's approval of the integrated shop test shall be obtained before any system components are shipped to the site for installation.
   2. Perform a point-by-point system demonstration of the Security System components including surveillance system, physical access control system, and intrusion detection system to show all systems functioning and communicating as required.
   3. Notify the Contracting Agency a minimum of 15 working days prior to demonstration so that the Contracting Agency may witness the demonstration.
   4. Conduct the demonstration in strict accordance with the test procedure accepted by the Contracting Agency. Demonstrate full compliance with the required operating modes and sequences of operation under all operating modes. Record demonstration/ test results on a report which shall include a list of all personnel witnessing the demonstration, test methods used, and a record of each specific test made.
   5. If demonstration results are not in compliance with requirements, make necessary hardware and software changes, corrections, repairs, or adjustments at no additional cost to the Contracting Agency. If corrections cannot be made during the scheduled Shop Test and another shop test is required, the Contractor shall pay for all transportation, lodging and expenses of the Contracting Agencys' (maximum seven people) attending the additional tests. This process shall continue until the systems are acceptable to the Contracting Agency.

2.06 FIRESTOPPING/SEALANT MATERIALS

A. Firestop and seal all penetrations of fire walls with minimum three-hour sealant or Fire Stop Putty (FSP). This includes but is not limited to all raceway, conductor, sleeve, and cable tray penetrations where penetrating device does not completely seal the hole.

B. Accepted Products: International Protective Coatings Corp. FlameSafe FSP 1100, Nelson FSP, Domtar Fire-Halt, or approved equal from other manufacturers.

PART 3 EXECUTION

3.01 EXAMINATION

A. Carefully inspect the installed Work by other trades and verify that all such Work is complete to the point where installation of the Work of this division may properly commence.

B. In the event of discrepancy, immediately notify the Contracting Agency. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.

C. Install all equipment in accordance with all pertinent codes and regulations, the accepted design, and the referenced standards.

3.02 INSTALLATION

A. Equipment Identification:
   1. Install a nameplate on each individual equipment rack, enclosure, boxes, cabinet, and significant equipment item.
   2. Use identifiers and abbreviations defined in the Drawings whenever possible. Use plan designation for labeling, unless indicated otherwise.
   3. Nameplates shall be laminated black phonemic resin with a white core and engraved lettering, a minimum of 1/4” high.
   4. Engrave using upper case letters of uniform height; centered on device, cover plate, or enclosure; with all characters made clearly and distinctly.
   5. All equipment shall have the manufacturer’s name, address, model number and rating on a name plate securely affixed in a conspicuous place. All equipment shall bear labels attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service.
   6. Identify all field terminals and relays with device identification. Lettering shall be 3/16” high minimum.

B. Equipment Installation:
   1. Install all equipment in accordance with the manufacturer's recommendations, and accepted shop drawings.
   2. Install all equipment in compliance with CEC requirements, NECA's "Standard of Installation", and recognized industry practices.
   3. If requested, submit structural and seismic mounting load calculations demonstrating adequate support and bracing for seismic zone 4.
   4. Do not attach electrical materials to roof decking, removable or knockout panels, or temporary walls and partitions unless indicated otherwise. Use hangers and other supports to support the equipment and materials, intended for this purpose.
   5. Locate equipment as close as practical to the locations shown on the Drawings.
   6. Maintain minimum 3-foot working clearances on each side of equipment or equipment racks where access is required to inspect, service or adjust.
   7. Check equipment against available mounting space indicated on the drawings. Coordinate location of equipment with existing devices to minimize interference. Bring all conflicts or clearance problems to the attention of the Contracting Agency during the preparation of shop drawings.
   8. Where the Contracting Agency determines that equipment installation is not conveniently accessible for operation and maintenance, remove and reinstall equipment in a conveniently accessible manner at no extra cost.

C. Grounding and Shielding:
   1. Comply with Section 27 05 26.

D. Surge Suppression:
   1. Comply with Section 27 05 26.

3.03 FIELD QUALITY CONTROL

A. Initial Performance Testing:
   1. Initial Performance Testing is to be conducted by the Contractor.
   2. Point-by-point testing shall include the sequential operation of each system and control function in each of its operating modes. All tests are to be conducted and recorded per the accepted procedure and test forms.
   3. Notify the Contracting Agency ten days in advance that this activity will be occurring.

B. Performance Verification Testing:
   1. Performance Verification Testing (PVT) is to be conducted by the Contractor and witnessed by the Contracting Agency.
   2. Schedule point-by-point PVT only after Initial Testing has been satisfactorily completed and all necessary corrections have been made. Provide the Contracting Agency with a minimum of 10 working days' notice with a request to schedule PVT. Submit Initial Performance Test records prior to the scheduled PVT. Failure to submit test results as specified shall be cause to re-schedule testing.
   3. Point-by-point testing shall include the sequential operation of each function in each of its operating modes, in addition to completion of all required performance testing and measurement.
   4. Conduct point-by-point PVT testing in the presence of Contracting Agency. Record test results on the accepted test checklist which shall include a list of all personnel witnessing the tests. If test results are not in compliance with requirements, make necessary changes or adjustments at no additional cost, and arrange for another test. This process shall continue until the systems are acceptable to the Contracting Agency.
   5. Failure of any part of the system which precludes completion of system testing, which cannot be repaired in four (4) hours, shall be cause for terminating the test. Retesting of the entire system shall be rescheduled at the convenience of the Contracting Agency, and Contractor shall bear the Contracting Agency's costs to complete retesting.
   6. PVT will also include inspections for contract document compliance, codes and standards compliance, and workmanship.

3.04 CLEANING

A. Comply with Section 1-06 requirements.

B. Protect equipment during installation against entry of foreign matter on the inside. Vacuum clean all equipment both inside and outside before testing, operating and painting. Clean electrical connections with a suitable solvent prior to assembly.

C. Remove from the premises and dispose of all packing material and debris daily.

D. Upon completion of the Work, remove excess debris, materials, equipment, apparatus, tools and the like and leave the premises clean, neat, and orderly.

E. Thoroughly polish all bright metal or plated Work and remove any pasted labels, dirt, or stains from the equipment.

3.05 TRAINING

A. Provide on-site, project-specific training sessions for system operations, maintenance, and programming with designated total hours as follows:

		Administrative	Operator
1.	Video Surveillance System	8/4/4	4/2/2
2.	Access Control System	8/4/4	4/2/2
3.	Intrusion Detection System	1/NA	1/NA

B. All classroom training is to occur on site at a location provided by the Contracting Agency.

C. All training is to review the existing systems as they apply to the equipment and systems provided under this contract. All personnel being trained are expected to have basic experience for the existing systems.

D. Operator Training:
   1. Train security staff in the operation of the System. Operational training shall include how to monitor and control the systems provided under this contract and how to respond to system events.

E. Administrator Training:
   1. Train Contracting Agency's personnel in the site-specific programming and software trouble shooting of the System. Training will also include all user programmable features. Conduct training sessions using instructors who have been actively involved throughout construction and who are certified in writing by the manufacturers of the specific systems.
   2. Provide a combination of classroom sessions supported by audio/visual aids, and field sessions with personnel participating in hands-on for programming changes, software uploading/downloading, trouble shooting, etc.
   3. Train Contracting Agency's personnel in the basic user level maintenance and troubleshooting of the System. Structure training to identify the equipment and systems that can be serviced or reset by the on duty building engineer, how to identify systems that have failed or not working, and emergency shut down procedures.
   4. Provide a combination of classroom sessions supported by audio/visual aids, and field sessions with personnel participating in hands-on preventative, corrective maintenance, and reactive maintenance.

F. Submit an estimated training schedule 15 days prior to training for approval by the Contracting Agency. Estimate classroom and hands-on hours required for all three types of training (operational, maintenance, and programming). Include a syllabus for each class session. Provide video recording, minimum 720p, of the training sessions on solid-state media.

G. All training materials including Operational and Maintenance (O&M) Manuals shall be reviewed and approved prior to conducting the specific training.

SCHEDULE 280500A
SAMPLE LIST OF DIVISION 28 SUBMITTALS

1. CPM Schedule
2. Submittal Matrix
3. Schedule of Values (SOV)
4. Licenses and certifications
5. Key Project Personnel
6. Product Data
7. Shop Drawings
    a. Floor Plans
    b. Enlarged Control / Equipment Rooms and Elevations
    c. Rack and Cabinet Elevations
    d. Block Diagrams
    e. Single Line Diagrams
    f. Point- to-Point Diagrams
    g. Schematic Diagrams
    h. Installation Diagrams and Details
8. Calculations; UPS, Data
9. Sequence of Operations
10. Samples
11. Test Procedures
12. Test Results
13. Record Documents
    a. Drawings
    b. O&M Manuals
    c. Warranty
14. Extra Materials

SCHEDULE 280500 B
SUMMARY OF REQUIRED LICENSES AND CERTIFICATIONS
This list is provided for the convenience of the Contractor only.

H. Section 28 05 00 Integrated Systems Contractors
   1. Key Personnel Degree or equal
   2. Local Contractors License
   3. Qualifications of licensed electrician performing work onsite.

END OF SECTION 28 05 00

This page intentionally left blank

SECTION 28 16 00
INTRUSION DETECTION SYSTEMS

PART 1 GENERAL

1.01 INTENT

A. Contractor to procure, provide, install, and make fully operational an Intrusion Detection System (IDS) with operational characteristics and capabilities which meet or exceed the product specification and technical performance parameters contained within this document and shown on the project drawings.

B. This IDS shall be installed in the Kitsap County North Road District Operations and Moderate Risk Waste Collection Facility as shown on the project drawings and described in these specifications.

1.02 SECTION INCLUDES

A. An intrusion detection system consisting of control panel, arming/disarming stations, door position sensors, motion detectors, glass-break detectors, and audible / visual notification appliances.

B. Physical access control system shall be integrated with systems specified in:
   1. Section 28 16 00 “Physical Access Control System.”
   2. Section 28 23 00 “Video Surveillance System.”

1.03 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

B. Section 28 05 00 “Common Work Results for Electronic Security Systems.”

C. Section 28 13 00 “Physical Access Control System.”

D. Section 28 23 00 “Video Surveillance System.”

1.04 DEFINITIONS

A. ACS: Above Ceiling Spaces.

B. ACP: Alarm Control Panel

C. DC: Door Contact / Door Position Sensor

D. GB: Glassbreak Detector

E. I/O: Input/Output

F. LAN: Local area network.

G. KYPD: Keypad Arming / Disarming Station

H. PC: Personal computer.

I. PIR: Passive Infrared Detector

J. PVT: Performance Verification Testing

K. RAM: Random Access Memory

L. TCP: Transmission control protocol - connects hosts on the Internet.

M. UPS: Uninterruptible power supply.

N. WAN: Wide area network.

1.05 ACTION SUBMITTALS

A. See Section 28 05 00 Common Work Results for Electronic Security Systems

1.06 INFORMATIONAL SUBMITTALS

A. See Section 28 05 00 Common Work Results for Electronic Security Systems

1.07 CLOSEOUT SUBMITTALS

A. See Section 28 05 00 Common Work Results for Electronic Security Systems

1.08 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NECA 1.

C. Comply with NFPA 70.

1.09 WARRANTY

A. See Section 28 05 00 Common Work Results for Electronic Security Systems

PART 2 PRODUCTS

2.01 QUALITY ASSURANCE

A. Manufacturer of any major component or system installed as a part of this project and not named as a basis of design shall have been in the business of manufacturing such component or system for a minimum of 5 years immediately preceding the date on this document.

B. Any major component or system installed as a part of this contract and not named as a basis of design shall have been installed in a minimum of 3 successfully completed projects of a similar size and scope. Contractor shall supply reference information with their proposal including project name, project location, and contact information for the system end-user.

2.02 BASIS OF DESIGN

A. Where a specific manufacturer's product is listed below, such product's performance characteristics and capabilities constitute the minimum acceptable, and any suggested alternates shall have characteristics and capabilities which meet or exceed the product named as the basis of design. Contractor may propose alternate products as follows:
   1. See Section 28 05 00 Common Work Results for Electronic Security Systems

2.03 IDS BASIS OF DESIGN TECHNICAL PERFORMANCE SPECIFICATIONS

A. Alarm Control Panel – Match existing. If no existing system or standard, Contractor shall utilize Digital Monitoring Products (DMP), or Contracting Agency approved equivalent.

B. Alarm Expansion Panels – Match existing. If no existing system or standard, Contractor shall utilize Digital Monitoring Products (DMP), or Contracting Agency approved equivalent.

C. Arming / Disarming Station - Match existing. If no existing system or standard, Contractor shall utilize Digital Monitoring Products (DMP), or Contracting Agency approved equivalent.

D. Door Position Sensor – Aritech or Contracting Agency approved equivalent, with sensor type based upon door construction (storefront system, hollow metal, wooden, etc.)

E. Motion Detector – Bosch or Contracting Agency approved equivalent

F. Glassbreak Detector - Bosch or Contracting Agency approved equivalent

G. Hard-Wired Duress Button – United Security Products Hub-2 or Contracting Agency approved equivalent.

H. Audible Notification Appliance – Common off the shelf 30-watt self-contained siren.

I. Visual Notification Appliance – Common off the shelf blue-colored strobe light.

2.04 POWER SUPPLIES

A. The control panel shall be equipped with backup batteries sufficient to provide 24 hours of standby operation and 10 minutes of alarm activation.

PART 3 EXECUTION

3.01 QUALITY ASSURANCE

A. Contractor shall be a factory authorized reseller / installer of all major components installed as a part of this project. Proof of such authorization shall be submitted as a part of the bid package

B. Contractor shall hold a valid alarm contractor license issued by the issuing authority in the State of Washington.

C. Contractor shall have successfully completed a minimum of 3 projects similar in size and scope to this one and shall submit references for such projects with their bid package. Reference shall include project name, location, type of facility, system(s) installed, and end-user contact information. It is expected that substantially the same personnel will be assigned to this project as participated in the referenced projects. This would include the project engineer, project manager, and lead installation technician. If any of these personnel were not involved in the referenced project, Contractor shall supply resumes for these employees documenting their experience and qualifications related to this project.

D. At a minimum, the lead installation technician assigned to this project shall be manufacturer certified in the installation of all major components installed as a part of this project.

3.02 SITE SPECIFIC SCOPES OF WORK

A. Exterior Areas – Provide and install systems, equipment, and infrastructure as shown on project drawings.

B. ROF – Provide and install systems, equipment, and infrastructure as shown on project drawings.

C. HHW - Provide and install systems, equipment, and infrastructure as shown on project drawings.

3.03 EXAMINATION

A. Examine pathway elements intended for IDS cabling. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation and / or operation, and other conditions affecting installation.

B. Examine roughing-in for all components before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 WIRING

A. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems", and Section 28 05 00 “Common Work Results for Electronic Security Systems”. In case of a discrepancy between the 2 sections, the more stringent requirements shall apply.

3.05 INTRUSION DETECTION SYSTEM INSTALLATION

A. IDS device locations shown on drawings are approximate, and Contractor shall verify final position with the Contracting Agency before any work is done.

B. Install all IDS components per manufacturer’s installation instructions.

C. Install control panel at location as directed by the Contracting Agency.

D. Install key locks on all enclosures

E. Identify system components, wiring, cabling, and terminals according to Section 26 05 53 "Identification for Electrical Systems."

3.06 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:
   1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
   2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Prepare IDS equipment for acceptance and operational testing as follows:
      a. Prepare equipment list described in "Informational Submittals" Article.
      b. Verify operation of all door contacts, motion, and glassbreak sensors.
      c. Verify proper communications for all reporting and restoral signals to central station.

d. Verify proper operation of workstation with PACS headend / software for logging alerts and events.
e. Verify all integration functionality with Surveillance System and PACS.

3. Performance Verification Test Schedule: See Section 28 05 00 Common Work Results for Electronic Security Systems

C. Intrusion detection system will be considered incomplete if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.07 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to TWO (2) visits to Project during normal business hours for this purpose. Tasks shall include, but are not limited to, the following:
1. Check cable connections.
2. Check proper operation of keypads and sensors.
3. Check proper operation of all integration driven functionalities.

3.08 CLEANING

A. Clean installed items using methods and materials recommended in writing by manufacturer.

B. Clean PACS components as needed.

3.09 TRAINING

A. Training on the surveillance system shall be as follows:
1. See Section 28 05 00 Common Work Results for Electronic Security Systems

END OF SECTION 28 16 00

SECTION 28 23 00
VIDEO SURVEILLANCE SYSTEM

PART 1 GENERAL

1.01 INTENT

A. Contractor procure, provide, install, and make fully operational an Electronic Video Surveillance System (EVSS) with operational characteristics and capabilities which meet or exceed the product specification and technical performance parameters contained within this document and shown on the project drawings.

B. This EVSS shall be installed in the Kitsap County North Road District Operations and Moderate Risk Waste Collection Facility as shown on the project drawings and described in these specifications.

1.02 SECTION INCLUDES

A. A video surveillance system consisting of:
   1. Fixed Interior Wall / Ceiling Mount Megapixel Camera
   2. Fixed Exterior Wall / Pole Mount Megapixel Camera
   3. Supplemental Illumination Devices
   4. Digital Video Recording and Management Software (DVRMS)
   5. System Servers (NIC, By Others)
   6. System Workstations / Review Monitor (NIC, By Others)
   7. Power and Data Cabling, Conduit, and Infrastructure

B. Video surveillance system shall be integrated with systems specified in:
   1. Section 28 16 00 Physical Access Control System
   2. Section 28 13 00 Intrusion Detection System

1.03 RELATED REQUIREMENTS

A. Section 28 05 00 Common Work Results for Electronic Security Systems

B. Section 28 13 00 Physical Access Control System

1.04 ABBREVIATIONS AND ACRONYMS

A. CPU = Central Processing Unit

B. DVD = Digital Video Disc

C. DVRMS = Digital Video Recording and Management System

D. FPS = Frames per Second

E. GB = Gigabyte

F. GBPS = Gigabyte per Second

G. HDD = Hard Disk Drive

H. HDMI = High-Definition Media Interface

I. IDS = Intrusion Detection System

J. IPS = Images per Second

K. LAN = Local Area Network

L. MB = Megabyte

M. MBPS = Megabyte per Second

N. NAS = Network Attached Storage

O. LED = Light Emitting Diode

P. PACS = Physical Access Control System

Q. RAID = Redundant Array of Independent Disks

R. RAM = Random Access Memory

S. SAN = Storage Attached Network
T. TCP/IP = Transport Control Protocol / Internet Protocol
U. UPS = Uninterruptable Power Supply
V. USB = Universal Serial Bus
W. PVT = Performance Verification Testing
X. V-LAN = Virtual Local Area Network
Y. VMS = See DVRMS
Z. VSS = Video Surveillance System
AA. WAN = Wide Area Network

1.05 REFERENCE STANDARDS

A. National Television System Committee - NTSC (North America)
B. Joint Photographic Experts Group – JPEG
C. Motion Joint Photographic Experts Group - MJPEG
D. Moving Picture Experts Group - MPEG
E. Underwriters Laboratory – UL
F. Federal Communications Commission – FCC
G. Interference Causing Equipment Standard – ICES (Canada)
H. Institute of Electronic and Electrical Engineers - IEEE
I. International Standards Organization – ISO
J. International Electrotechnical Commission -IEC
K. Restriction of Hazardous Substances Directive (RoHS)

1.06 ACTION SUBMITTALS

A. See Section 28 05 00 Common Work Results for Electronic Security Systems

1.07 INFORMATIONAL SUBMITTALS

A. See Section 28 05 00 Common Work Results for Electronic Security Systems

1.08 CLOSEOUT SUBMITTALS

A. See Section 28 05 00 Common Work Results for Electronic Security Systems

1.09 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with NECA 1.
C. Comply with NFPA 70.

1.10 WARRANTY

A. See Section 28 05 00 Common Work Results for Electronic Security Systems

PART 2 PRODUCTS

2.01 QUALITY ASSURANCE

A. Manufacturer of any major component or system installed as a part of this project and not named as a basis of design shall have been in the business of manufacturing such component or system for a minimum of 5 years immediately preceding the date on this document.
B. Any major component or system installed as a part of this contract and not named as a basis of design shall have been installed in a minimum of 3 successfully completed projects of a similar size and scope. Contractor shall supply reference information with their proposal including project name, project location, and contact information for the system end-user.

2.02 BASIS OF DESIGN

A. Kitsap County has selected a cloud managed EVSS. As such, all surveillance system equipment shall be by Verkada with no equivalent.

B. Where a specific manufacturer's product is listed below that is not called out as no equivalent, such product's performance characteristics and capabilities constitute the minimum acceptable, and any suggested alternates shall have characteristics and capabilities which meet or exceed the product named as the basis of design. Contractor may propose alternate products as follows:

1. See Section 28 05 00 Common Work Results for Electronic Security Systems

2.03 EVSS BASIS OF DESIGN TECHNICAL PERFORMANCE SPECIFICATIONS

A. Fixed Interior Wall / Ceiling Mount Megapixel Camera – Verkada with no equivalent.

B. Fixed Exterior Wall / Pole Mount Megapixel Camera - Verkada with no equivalent.

C. Interior Pan, Tilt, Zoom (PTZ) Wall / Ceiling Mount Megapixel Camera - Verkada with no equivalent.

D. Exterior Pan, Tilt, Zoom (PTZ) Wall / Pole Mount Megapixel Camera - Verkada with no equivalent.

E. Supplemental Illumination Devices - Verkada with no equivalent.

F. Digital Video Recording and Management Software (DVRMS) - Verkada with no equivalent.

G. System Servers - Verkada with no equivalent.

H. System Workstations / Review Monitor – By Contracting Agency, NIC.

2.04 POWER SUPPLIES

A. All system components to be connected to a UPS providing a minimum of 4 hours back-up power.

B. The control panel shall be equipped with backup batteries sufficient to provide 24 hours of standby operation and 10 minutes of alarm activation.

2.05 CABLING AND INFRASTRUCTURE

A. All cabling and infrastructure to be per Kitsap County standards. Where no standard applies, BICSI, TIA/EIA, and Division 27 Codes and Standards shall apply.

PART 3 EXECUTION

3.01 QUALITY ASSURANCE

A. Contractor shall be a factory authorized reseller / installer of all major components installed as a part of this project. Proof of such authorization shall be submitted as a part of the bid package

B. Contractor shall hold licenses as required by local, state, or federal agencies.

C. Contractor shall have successfully completed a minimum of 3 projects similar in size and scope to this one and shall submit references for such projects with their bid package. Reference shall include project name, location, type of facility, system(s) installed, and end-user contact information. It is expected that substantially the same personnel will be assigned to this project as participated in the referenced projects. This would include the project engineer, project manager, and lead installation technician. If any of these personnel were not involved in the referenced project, Contractor shall supply resumes for these employees documenting their experience and qualifications related to this project.

D. At a minimum, the lead installation technician assigned to this project shall be manufacturer certified in the installation of all major components installed as a part of this project.

3.02 SITE SPECIFIC SCOPES OF WORK

A. Exterior Areas – Provide and install systems, equipment, and infrastructure as shown on project drawings.

B. ROF – Provide and install systems, equipment, and infrastructure as shown on project drawings.

C. HHW - Provide and install systems, equipment, and infrastructure as shown on project drawings.

3.03 EXAMINATION

A. Examine pathway elements intended for EVSS cabling. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation and / or operation, and other conditions affecting installation.

B. Examine roughing-in for all components before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 WIRING

A. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

B. Wiring Method: Install cables in raceways and or conduit unless otherwise indicated.
   1. Except raceways are not required in accessible indoor ceiling spaces and attics, where Contractor shall utilize self-supported J-hooks.
   2. Except raceways are not required in hollow gypsum board partitions.
   3. Conceal raceways and wiring except in unfinished spaces.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

E. For LAN connection and fiber-optic and copper communication wiring, comply with:
   1. Section 27 13 13 "Communications Copper Backbone Cabling"
   2. Section 27 13 23 "Communications Optical Fiber Backbone Cabling"
   3. Section 27 15 13 "Copper Horizontal Cabling."

F. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.05 ELECTRONIC VIDEO SURVEILLANCE SYSTEM INSTALLATION

A. EVSS device locations shown on drawings are approximate, and Contractor shall verify final position with the Contracting Agency before any work is done.

B. Install all EVSS components per manufacturer’s installation instructions.

C. Install control panel at location as directed by the Contracting Agency.

D. Install key locks on all enclosures

E. Identify system components, wiring, cabling, and terminals according to Section 26 05 53 "Identification for Electrical Systems."

3.06 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:
   1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
   2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Prepare IDS equipment for acceptance and operational testing as follows:
      a. Prepare equipment list described in "Informational Submittals" Article.
      b. Verify operation of all cameras.
      c. Verify proper recording and playback functionality.

d. Verify proper operation of workstation with EVSS headend / software for logging alerts and events.
e. Verify all integration functionality with Access Control and Intrusion Detection Systems.

3. Performance Verification Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 14 working days' notice of test schedule.
   a. Contractor shall prepare and submit to the Contracting Agency a PVT plan showing a structured and complete testing procedure. This PVT plan shall be submitted to the Contracting Agency a minimum of 14 working days prior to planned start of testing.
   b. PVT plan shall show equipment being tested, means of testing, and pass/fail criteria.
   c. PVT form shall include space for Contractor / Contracting Agency initials on each testing phase, along with a signature page with PVT results and follow-up notes.
4. Should any component of the system fail TWO (2) consecutive PVT tests, the Contractor shall be liable for costs incurred by the Contracting Agency to provide personnel for further PVT testing.

C. Electronic video surveillance system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.07 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to TWO (2) visits to Project during normal business hours for this purpose. Tasks shall include, but are not limited to, the following:
   1. Check cable connections.
   2. Check proper operation of cameras and VMS
   3. Check proper operation of all integration driven functionalities.

3.08 CLEANING

A. Clean installed items using methods and materials recommended in writing by manufacturer.

B. Clean EVSS components as needed.

3.09 TRAINING

A. See Section 28 05 00 Common Work Results for Electronic Security Systems

END OF SECTION 28 23 00

This page intentionally left blank

SECTION 28 46 21
ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire-alarm control unit.

B. Manual fire-alarm boxes.

C. System smoke detectors.

D. Non-system smoke detectors.

E. Heat detectors.

F. Notification appliances – Speakers and Strobes

G. Device guards.

H. Firefighters' smoke-control station.

I. Remote annunciator.

J. Addressable interface device.

K. Digital alarm communicator transmitter.

L. Radio alarm transmitter.

1.02 RELATED REQUIREMENTS

A. Section 27 15 13 "Communications Copper Horizontal Cabling" for cables and conductors for fire-alarm systems.

1.03 RELATED DOCUMENTS

A. Section 28 05 00 “Common Work Results For Electronic Safety And Security.”

1.04 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

1.05 SCOPE

A. Contractor shall provide design and installation of addressable fire alarm system with voice evacuation. Provide initiating devices, notification speakers and strobes per latest NFPA 72 and Washington state fire code.

1.06 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.
   1. Include construction details, material descriptions, dimensions, profiles, and finishes.
   2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.
   1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   2. Include plans, elevations, sections, details, and attachments to other work.
   3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
   4. Detail assembly and support requirements.
   5. Include voltage drop calculations for notification-appliance circuits.

6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
    d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
    e. Locate detectors according to manufacturer's written recommendations.
    f. Show air-sampling detector pipe routing.
13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:
1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level III Level IV minimum.
    c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.07 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Data: Certificates, for fire-alarm control unit, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.08 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 1-11"Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction :
      a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
      b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
      c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
      d. Riser diagram.
      e. Device addresses.
      f. Record copy of site-specific software.
      g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
         1) Equipment tested.
         2) Frequency of testing of installed components.
         3) Frequency of inspection of installed components.
         4) Requirements and recommendations related to results of maintenance.
         5) Manufacturer's user training manuals.
      h. Manufacturer's required maintenance related to system warranty requirements.
      i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On magnetic media or compact disk, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.09 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
   2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
   3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
   4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
   5. Keys and Tools: One extra set for access to locked or tamper proofed components.
   6. Audible and Visual Notification Appliances: One of each type installed.
   7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

E. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FM Global-approved alarm company.

F. NFPA Certification: Obtain certification according to NFPA 72 by UL listed fire alarm company.

1.11 PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.

B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
   1. Notify Architect Construction Manager Owner no fewer than seven days in advance of proposed interruption of fire-alarm service.
   2. Do not proceed with interruption of fire-alarm service without Architect's Construction Manager's Owner's written permission.

C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

D. The project is the renovation of existing office building having existing fire alarm system interconnected with other buildings in the campus. Existing fire alarm system in the renovated office building shall be kept functional throughout the construction time. 'Fire watch' will be required only when the fire alarm system is not functional in the occupied spaces. Based on construction phasing, contractor shall determine times when fire alarm system will be down in occupied spaces and fire watch duration will be based on that. Include cost for necessary fire watch in bid to accomplish fire alarm system installation.

1.12 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.13 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
   1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Silent Knight by Honeywell.
   2. Edwards, UTC.
   3. NOTIFIER; a Honeywell company.
   4. SimplexGrinnell LP; a Tyco International company.

2.02 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified FM Global-placarded addressable system, with multiplexed signal transmission and voice speaker/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Provide voice evacuation system with speakers and strobes.

2.03 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Carbon monoxide detectors.
6. Automatic sprinkler system water flow.
7. Fire-extinguishing system operation.
8. Dry system pressure flow switch.

B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances, including voice evacuation notices.
2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
8. Activate smoke-control system (smoke management) at firefighters' smoke-control system panel.
9. Activate stairwell and elevator-shaft pressurization systems.
10. Close smoke dampers in air ducts of designated air-conditioning duct systems.
11. Activate preaction system.
12. Recall elevators to primary or alternate recall floors.
13. Activate elevator power shunt trip.
14. Activate emergency lighting control.
15. Activate emergency shutoffs for gas and fuel supplies.
16. Record events in the system memory.
17. Record events by the system printer.
18. Indicate device in alarm on the graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
3. Alert and Action signals of air-sampling detector system.
4. Elevator shunt-trip supervision.
5. User disabling of zones or individual devices.
6. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.

7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Voice signal amplifier failure.

E. System Supervisory Signal Actions:
1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit , connected network control panels, off-premises network control panels, and remote annunciators .
3. Record the event on system printer.
4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
5. Transmit system status to building management system.
6. Display system status on graphic annunciator.

2.04 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event ."

2.05 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
b. Include a real-time clock for time annotation of events on the event recorder and printer.
c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays in each building and provide communication between the buildings.
d. The FACP shall be listed for connection to a central-station signaling system service.
e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, three line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
1. Pathway Class Designations: NFPA 72, Class A.
2. Pathway Survivability: Level 0.

3. Install no more than total capacity of the panel with addressable devices on each signaling-line circuit. Keep 20% spare capacity.
4. Serial Interfaces:
    a. One dedicated RS 485 port for central-station operation using point ID DACT.
    b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
    c. One RS 232 port for PC configuration.
    d. One RS 232 port for VESDA HLI connection.
    e. One RS 232 port for voice evacuation interface.

D. Stairwell and Elevator Shaft Pressurization: Provide an output signal using an addressable relay to start the stairwell and elevator shaft pressurization system. Signal shall remain on until alarm conditions are cleared and fire-alarm system is reset. Signal shall not stop in response to alarm acknowledge or signal silence commands.
1. Pressurization starts when any alarm is received at fire-alarm control unit.
2. Alarm signals from smoke detectors at pressurization air supplies have a higher priority than other alarm signals that start the system.

E. Smoke-Alarm Verification:
1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

J. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.
1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.
    a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
    b. Programmable tone and message sequence selection.
    c. Standard digitally recorded messages for "Evacuation" and "All Clear."

d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

K. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

L. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals shall be powered by 24-V dc source.
1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

M. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
1. Batteries: Sealed, valve-regulated, recombinant lead acid.

N. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.06 PREACTION SYSTEM

A. Initiate Presignal Alarm: This function shall cause an audible and visual alarm and indication to be provided at the FACP. Activation of an initiation device connected as part of a preaction system shall be annunciated at the FACP only, without activation of the general evacuation alarm. Provide monitoring capability to dry pipe pre-action system through flow switch.

2.07 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Single-action mechanism, breaking-glass or plastic-rod pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.
4. Provide pull stations in bulking room, tire changing, maintenance bay or any hazardous area where the possibility of fire is more.

2.08 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.

5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status .
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit .
    a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
    b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
    c. Multiple levels of detection sensitivity for each sensor.
    d. Sensitivity levels based on time of day.

B. Photoelectric Smoke Detectors:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.09 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.
1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.10 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
   1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
   1. Rated Light Output:
      a. 15/30/75/110 cd, selectable in the field.
   2. Mounting: Wall mounted unless otherwise indicated.
   3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
   4. Flashing shall be in a temporal pattern, synchronized with other units.
   5. Strobe Leads: Factory connected to screw terminals.
   6. Mounting Faceplate: Factory finished, red white .

C. Voice/Tone Notification Appliances:
   1. Comply with UL 1480.
   2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
   3. High-Range Units: Rated 2 to 15 W.
   4. Low-Range Units: Rated 1 to 2 W.
   5. Mounting: surface mounted and bidirectional.
   6. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.11 GRAPHIC ANNUNCIATOR

A. Graphic Annunciator Panel: Mounted in an aluminum frame with nonglare, minimum 3/16-inch- (4.76-mm-) thick, clear acrylic cover over graphic representation of the facility. Detector locations shall be represented by red LED lamps. Normal system operation shall be indicated by a lighted, green LED. Trouble and supervisory alarms shall be represented by an amber LED.
   1. Comply with UL 864.
   2. Operating voltage shall be 24-V dc provided by a local 24-V power supply provided with the annunciator.
   3. Include built-in voltage regulation, reverse polarity protection, RS 232/422 serial communications, and a lamp test switch.
   4. Surface mounted in a NEMA 250, Type 1 cabinet, with key lock and no exposed screws or hinges.
   5. Graphic representation of the facility shall be a CAD drawing and each detector shall be represented by an LED in its actual location. CAD drawing shall be at 1/8-inch per foot (10-mm per meter) scale or larger.
   6. The LED representing a detector shall flash two times per second while detector is an alarm.

2.12 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
   1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.13 ADDRESSABLE INTERFACE DEVICE

A. General:
   1. Include address-setting means on the module.
   2. Store an internal identifying code for control panel use to identify the module type.
   3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall, to circuit-breaker shunt trip for power shutdown.
   1. Allow the control panel to switch the relay contacts on command.
   2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:
   1. Operate notification devices.
   2. Operate solenoids for use in sprinkler service.

2.14 NETWORK COMMUNICATIONS

A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.

B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

C. Provide integration gateway using BACnet, Modbus for connection to building automation system.

2.15 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
   1. Factory fabricated and furnished by device manufacturer.
   2. Finish: Paint of color to match the protected device.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
   1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
   1. Devices placed in service before all other trades have completed cleanup shall be replaced.
   2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
   1. Connect new equipment to existing control panel in existing part of the building.
   2. Connect new equipment to existing monitoring equipment at the supervising station.
   3. Expand, modify, and supplement existing control monitoring equipment as necessary to extend existing control monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

C. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.
   1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."

D. Manual Fire-Alarm Boxes:
   1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
   2. Mount manual fire-alarm box on a background of a contrasting color.
   3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.

E. Smoke- or Heat-Detector Spacing:
   1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
   2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
   3. Smooth ceiling spacing shall not exceed 30 feet (9 m)
   4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
   5. HVAC: Locate detectors not closer than 36 inches (910 mm) from air-supply diffuser or return-air opening.
   6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

F. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

G. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.
   1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

H. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

I. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

J. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

K. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and speakers on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

L. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm speaker and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.

M. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.03 PATHWAYS

A. Pathways above recessed ceilings and in non accessible locations may be routed exposed.
   1. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

3.04 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 08 71 00 "Door Hardware." Connect hardware and devices to fire-alarm system.
   1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
   2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
   3. Smoke dampers in air ducts of designated HVAC duct systems. Provide required smoke detectors in the space served by the duct for smoke detection and smoke damper shutdown in the event of fire alarm.
   4. Magnetically held-open doors.
   5. Electronically locked doors and access gates.
   6. Alarm-initiating connection to elevator recall system and components.
   7. Alarm-initiating connection to activate emergency lighting control.
   8. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
   9. Supervisory connections at valve supervisory switches.
   10. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
   11. Supervisory connections at elevator shunt-trip breaker.
   12. Data communication circuits for connection to building management system.
   13. Data communication circuits for connection to mass notification system.
   14. Supervisory connections at fire-extinguisher locations.
   15. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
   16. Supervisory connections at fire-pump engine control panel.

3.05 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 27 05 53 "Identification for Communications Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.06 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.07 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by Architect authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative :
   1. Visual Inspection: Conduct visual inspection prior to testing.
      a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
      b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
   2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
   3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
   4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
   5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
   6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.08 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
   2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
   3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.09 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 46 21

This page intentionally left blank

SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

This Section includes site clearing, grubbing and stripping, and removal of other unsuitable material within limits of clearing.

PART 2 PRODUCTS - NOT USED.

PART 3 EXECUTION

3.01 PREPARATION

A. Protect existing trees and other vegetation to remain against damage:
   1. Provide silt and construction fencing as shown in the plans.
   2. No construction equipment or activities shall be allowed beyond the construction fencing with the exception of any work absolutely necessary to complete the work and as approved by the Contracting Agency.

1.01 SITE CLEARING

B. Tree Removal
   1. Cut trees as shown on the plans and in accordance with Forest Practices Permit shown in Appendix C. The merchantable trees on site shall be the property of the Contractor.

C. Topsoil Removal
   1. Strip topsoil to 12 inches depth.
      a. Stop topsoil stripping at dripline of trees not designated for removal to prevent damage to main root system.
      b. Separate from underlying subsoil or objectionable material.
   2. Stockpile topsoil for subsequent reuse as amended backfill for planting areas.
      a. Cover with weed barrier material that sheds moisture yet allows air transmission, in approved location, prior to grading
      b. After the completion of planting, any excess unused stockpiled topsoil shall be disposed off-site by the contractor at no expense to the owner.

D. Disposal of Waste Materials
   1. Do not burn combustible materials on site.
   2. Remove all vegetative waste from the site and transport to an appropriate composting facility.
   3. Do not bury organic matter on site.

1.02 ACCEPTANCE

Upon completion of the site clearing, obtain the Contracting Agency's acceptance of the extent of clearing, depth of stripping, and rough grade.

END OF SECTION 31 10 00

This page intentionally left blank

SECTION 31 20 00
EARTHWORK

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. All earthwork shall be in accordance with the Washington State Department of Transportation and American Public Works Association (WSDOT/APWA) Washington State Chapter Standard Specifications for Road, Bridge, and Municipal Construction, current edition, Sections 2-03, 2-06, 2-09, and other sections as specified or applicable.

B. WSDOT/APWA Standard Plans for Road, Bridge and Municipal Construction, Current Edition.

C. This Section includes the following:
   1. Preparing subgrades for walks, pavements, lawns, and plantings.
   2. Excavating and backfilling for buildings and structures.

1.02 REFERENCES

A. Related Sections include the following:
   1. Section 1-07.17 – Utilities and Similar Facilities
   2. Section 1-10 – Traffic Control
   3. WSDOT Standard Specification Sections 2-03, 2-06, and 2-09
   4. Section 31 25 00 – Erosion and Sedimentation Controls Section 31 10 00 – Site Clearing
   5. Section 33 46 00 – Stormwater Management
   6. Appendix B – NKSC Geotech Report Aspect November 2022 Exploration Logs

1.03 DEFINITIONS

A. Additional Excavation: Excavation below subgrade elevations as directed by Contracting Agency's representative. Additional excavation and replacement material will be paid for according to Section 1-09.2(7) for changes in the Work.

B. Excavation below subgrade to remove soft and non-compactable material.

C. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Contracting Agency's representative. Unauthorized excavation, as well as remedial work directed by Contracting Agency's representative, shall be without additional compensation.

PART 2 PRODUCTS

2.01 SUBMITTALS

A. Materials
   1. Gravel Borrow: Shall consist of granular material, either naturally occurring or process, and shall meet the following requirements for grading and quality:

SCREEN SIZE	PERCENT PASSING
3"	100
1 ½"	70 - 100
¾"	50 - 85
#4	30 – 60
#40	8 – 24
#200	3 - 10
SAND EQUIVALENT	35 MINIMUM

B. Submittals
   1. See Specification Sections 1-04.3(7) & 1-06.1 for submittal requirements.

2. Shoring Design: In accordance with WSDOT Standard Specification Sections 2-09.3(3) and 2-09.3(4). Where shoring (using other than pre-engineered systems) is determined by the Contractor to be necessary, submit proposed excavation shoring method for review at least two weeks prior to commencement of excavation requiring shoring. Submit, all at one time, in a neat orderly form, the following information:
   a. Basic design assumptions.
   b. Design calculations.
   c. The shop drawings to which the shoring system shall be constructed.
   d. Certification of the above by a registered professional civil or structural engineer licensed by the State of Washington.
   e. Submit four (4) copies; one will be returned.
3. When operations affect traffic, traffic control shall be provided for in accordance with Section 1-10 Traffic Control.
4. Dewatering Plan: Submit proposed dewatering method for review at least two weeks prior to commencement of excavation requiring dewatering. Submit, all at one time, in a neat orderly form, the following information:
   a. Basic design assumptions.
   b. Design calculations for discharge and treatment.
   c. The shop drawings to which the dewatering system shall be installed.
   d. Certification of the above by a registered professional civil engineer or hyrogeologist licensed by the State of Washington.
   e. Submit four (4) copies; one will be returned.

PART 3 EXECUTION

3.01 PREPARATION

A. In accordance with WSDOT Standard Specification Sections 2-03 and 2-09.

B. Protect subgrade soils against freezing temperatures or frost, water saturation, construction traffic degradation, or excessive drying. Provide protective insulating materials as necessary to prevent freezing or frost, water saturation, or excessive drying and materials to prevent traffic degradation.

C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

D. Before placement of any fill, subgrade shall be inspected by the geotechnical engineer to identify soft, yielding, or unsuitable soils.

3.02 DEWATERING

A. In accordance with WSDOT Standard Specification Sections 2-03 and 2-09.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
   1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
   2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations as needed. Maintain until dewatering is no longer required. At the termination of dewatering, all wells shall be abandoned in accordance with Washington Administrative Code (WAC) 173-160.

3.03 EXCAVATION, GENERAL

A. In accordance with WSDOT Standard Specification Sections 2-03, 2-09, and 7-08.

3.04 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing bearing pad. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended for bearing surface.

B. Subgrade preparation: Preparation in accordance with WSDOT Standard Specification Section 2-06. Exposed subgrades shall be prepared by removing loosened soils where practical and recompacting the subgrade surface to a firm, unyielding state, Localized zones of loose granular soils observed within a subgrade shall be compacted to a density commensurate with the surrounding soils. Organic, soft, or pumping soils observed within a subgrade shall be overexcavated and replaced with a suitable structural fill material. Geotextile separator shall be laid on the subgrade prior to structural fill placement.

3.05 UNSUITABLE FOUNDATION EXCAVATION

A. In accordance with WSDOT Standard Specification Section 2-03.3(14)E.

3.06 FILL

A. Native materials shall be used when suitable unless otherwise shown on the Plans, or directed by the Engineer.

B. Place and compact backfill in accordance with WSDOT Standard Specification Sections 2-03.3(14)C Method C and 2-09.3(1)E.

C. Fill
1. Fill materials used to establish grade shall be gravel borrow in accordance with WSDOT Standard Specification Section 9-03.14(1).
2. To ensure uniform bearing conditions for slabs overlying structural fill, the fill shall be no less than 2 feet thick (vertical) and depth of structural fill shall vary by no more than 20% across the slab area.
3. Fill slopes should be compacted by slope rolling and trimming, or should be overfilled and trimmed back to plan grade to expose a firm, smooth surface free of loose material.

3.07 MOISTURE CONTROL

A. The Contractor may use on-site materials for construction of grades in conformance with this Section.
1. The Contractor shall conduct his operation so as to utilize on-site suitable materials by:
   a. Uniformly moisture condition “drying” or “wetting” the subgrade and each subsequent fill or backfill layer before compaction to within 2 percent above or below optimum moisture content.
   b. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
   c. Limit the areas that are stripped of topsoil and exposed during wet weather. The Contractor is responsible for over-excavation of material beneath subgrade that becomes unsuitable because it is left exposed, saturated, damaged, or adversely affected by the Contractor’s work.
   d. Do no place backfill or fill material on surfaces that are muddy, frozen, contain frost or ice, saturated, soft or exhibit pumping.

END OF SECTION 31 20 00

This page intentionally left blank

SECTION 31 25 14
SOIL EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. In accordance with Standard Specification 8-01.1. Supplement this section with the following:

Kitsap County has applied for a Washington State Department of Ecology NPDES Construction Stormwater General Permit for this project. The County anticipates the permit to be issued prior to the start of construction. The Contractor shall assume and transfer the permit into their name and include in the bid full compliance and administration with the requirements of the General Permit for this Project.

This work shall include the preparation and implementation of a Temporary Erosion and Sedimentation Control (TESC) Plan by the Contractor for this contract.

1.02 SUBMITTALS

A. Delete the first sentence of Standard Specification 8-01.3(1)A and replace it with the following:

The Contractor shall prepare a temporary erosion and sedimentation control (TESC) Plan for the contract and shall submit this TESC Plan to the Engineer 5 days prior to the preconstruction conference.

A TESC Plan consists of a narrative section and plan sheets that meets Ecology's Stormwater Pollution Prevention Plan (SWPPP) requirement in the CSWGP. When the Contracting Agency has developed a TESC Plan for a Contract the narrative is included in the appendix to the Special Provisions and the TESC plan sheets are included in the Contract Plans. The Contracting Agency TESC plan will not include off-site areas used to directly support construction activity.

A Stormwater Pollution Prevention Plan (SWPPP) shall be prepared by the Contractor and submitted for approval by the Engineer. The plan shall consist of the Contractor's complete strategy to meet the requirements of the CSWGP. The SWPPP shall include and modify as necessary the TESC Plan drawings if provided as part of the Contact Plans. The Contractor shall prepare, review and modify the SWPPP as necessary to be consistent with the actual work schedule, sequencing, and construction methods that will be used on the project.

The SWPPP shall document all the erosion and sediment control Best Management Practices (BMPs) proposed, whether permanent or temporary. The plan shall document installation procedures, materials, scheduling, and maintenance procedures for each erosion and sediment control BMP. The Contractor shall submit the SWPPP for the Engineer's approval before any work begins. The Contractor shall allow at least five working days for the Engineer's review of the initial SWPPP or any revisions to the modified SWPPP. Failure to approve all or part of any such plan shall not make the Contracting Agency liable to the Contractor for any work delays. The Contractor may not begin work without an approved Contractor's SWPPP.

Contractor TESC Plans shall include all high visibility fence delineation shown on the Contracting Agency Contract Plans. All TESC Plans shall meet the requirements of the current edition of the WSDOT Temporary Erosion and Sediment Control Manual M 3109 and be adapted as needed throughout construction based on site inspections and discharge samples to maintain compliance with the CSWGP. The Contractor shall develop a schedule for implementation of the TESC work and incorporate it into the Contractor's progress schedule.

The Contractor shall submit their TESC Plan and implementation schedule as Type 2 Working Drawings. At the request of the Engineer, updated TESC Plans shall be submitted as Type 1 Working Drawings.

PART 2 PRODUCTS

2.01 MATERIALS

A. In accordance with Standard Specification 8-01.2.

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. In accordance with Standard Specification 8-01.3

3.02 CLEAN UP

A. Clean out sediment control structures that are to remain as permanent measures.

END OF SECTION 31 25 14

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This Section includes providing surfacing under HMA and Portland Cement Concrete pavement as shown in the plans.

1.02 REFERENCES

A. In accordance with WSDOT Standard Specification Sections 4-04.1 through 4-04.3(10).

PART 2 PRODUCTS

2.01 MATERIALS

A. In accordance with WSDOT Standard Specification Section 4-04.2.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with WSDOT Standard Specification 4-04.3

END OF SECTION 32 11 23

This page intentionally left blank

SECTION 32 12 16
HOT MIX ASPHALT (HMA) PAVING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. In accordance with WSDOT Specification 5-04.1

PART 2 PRODUCTS

A. Hot Mix Asphalt: HMA Class ½-inch PG 64-22 in accordance with WSDOT Specification 5-04.2

PART 3 EXECUTION

A. In accordance with WSDOT Specification 5-04.3.

END OF SECTION 32 12 16

This page intentionally left blank

SECTION 32 13 13
RIGID CONCRETE PAVEMENT

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This Section includes providing Rigid Concrete pavement as shown in the plans.

1.02 REFERENCES

A. In accordance with WSDOT Standard Specification Section 5-05.

PART 2 PRODUCTS

2.01 MATERIALS

A. In accordance with WSDOT Standard Specification Section 5-05.2.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with WSDOT Standard Specification 5-05.3

END OF SECTION 32 13 13

This page intentionally left blank

SECTION 32 16 23
SIDEWALKS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This Section includes provide sidewalk and other pedestrian walkways adjacent to buildings and parking stalls:

PART 2 PRODUCTS

2.01 MATERIALS

A. In accordance with Standard Specification Section 8-14.2.

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. In accordance with Standard Specification Section 8-14.3.

END OF SECTION 32 16 23

This page intentionally left blank

SECTION 32 17 13
PARKING BUMPERS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This Section includes the installation of precast traffic curb as described in the plans.

1.02 SUBMITTALS

PART 2 PRODUCTS

2.01 MATERIALS

A. https://www.whitecap.com/p/quikrete-6-concrete-car-stop-parking-bumper-168947/99225/113cpb60

B. https://www.nitterhousemasonry.com/our-products/concrete-parking-stop-blocks/

C. https://www.trafficsafetywarehouse.com/8-Concrete-Parking-Curb-w_Forklift-Knockouts/productinfo/PC-8/

D. Approved equal.

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Shall be positively affixed to the pavement in accordance with manufacturers recommendations and to the satisfaction of the Contracting Agency.

END OF SECTION 32 17 13

This page intentionally left blank

SECTION 32 17 23
PAVEMENT MARKINGS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This Section includes the application of pavement markings as shown in the plans:

1.02 SUBMITTALS

PART 2 PRODUCTS

2.01 MATERIALS

A. In accordance with Standard Specification Section 8-22.2.

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. In conformance with Standard Specification Section 8-22.3
   1. Position pavement markings as indicated on drawings.

END OF SECTION 32 17 23

This page intentionally left blank

SECTION 32 17 26
DETECTABLE WARNING SURFACING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The installation of detectable warning surfaces as shown in the plans.

1.02 SUBMITTALS

A. Product Data: Provide data on Detectable Warning Surfaces

B. Samples: Submit a sample indicating construction and colored finish

PART 2 PRODUCTS

2.01 DETECTABLE WARNING SURFACES

A. In accordance with Standard Specification Section 8-14.2 and 9-19.

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Install in accordance with Standard Specification 8-14.3.

B. Field Adjustment:
   1. Locate relative to curb line in compliance with ATBCB PROWAG, Sections 304 and 305.
   2. Orient so dome pattern is aligned with the direction of ramp.

END OF SECTION 32 17 26

This page intentionally left blank

SECTION 32 31 13
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The installation of chain link fencing and gates as shown in the plans.

PART 2 PRODUCTS

2.01 MATERIALS

A. Vinyl coated chain link fencing in accordance with Standard Specification Section 8-12.2.

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Vinyl coated chain link fencing
   1. In accordance with Standard Specification 8-12.3.

END OF SECTION 32 31 13

This page intentionally left blank

SECTION 32 31 13.01
MOTORIZED CANTILEVER SLIDE GATES

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The installation of 30 feet wide and 40 feet wide motorized cantilever slide gates as shown in the plans.

PART 2 PRODUCTS

2.01 PRODUCTS

A. Fortress Structural Cantilever slide Gate, Tymetal https://www.tymetal.com/industrial-commercial/cantilever-gates/, black

B. Ultra Aluminum Industrial Cantilever Gates, https://www.ultrafence.com/cantilevergates.html, textured black

C. MerchantsMetal, Secure-Trac, https://www.merchantsmetals.com/secure-trac/, black vinyl chain link

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Install in accordance with manufacturers specifications and instructions.

END OF SECTION 32 31 13.01

This page intentionally left blank

SECTION 32 31 37
AUTOMATIC BARRIER GATES

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The installation of automatic barrier gates, and their concrete foundations, at the Household Hazardous Waste Collection Facility as shown on the plans. This gate is to be manually actuated by facility operators.

1.02 SUBMITTALS

A. Shop Drawings and/or catalog cuts.

B. Detail of concrete foundation as recommended by the manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS

A. DoorKing 1601 Barrier Gate Opener (https://barrier-gate.com/doorking-1601-barrier-gate-operator) with 12-foot-long arm.

B. Parking BOXX BGS-522 (https://parkingboxx.com/barrier-gates) with 12=foot-long arm.

C. LiftMaster Mega Arm High Performance Commercial DC Barrier Gate (https://www.liftmaster.com/ma-mega-arm-barrier-gate-operators/p/MA#spec) with 12-foot-long arm.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with the location identified in the plans and with manufacturer's instructions. See civil plans for location, and electrical plans for actuation switch.

END OF SECTION 32 31 37

This page intentionally left blank

SECTION 32 32 60
MATERIAL STORAGE, BRINE MAKER, SALT STORAGE WALLS AND ROOFS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This Section includes the construction of gravity block walls and roofs for material storage, brine maker, and salt storage. These walls include gravity block walls detailed in the Plans and contractor designed walls with roof structures for salt storage, and for brine maker/brine pump and street sweepings storage.

1.02 DEFINITIONS

A. Gravity block walls are a wall system comprised of prefabricated modular reinforced concrete units that derive their stability primarily from their own weight.

1.03 REFERENCES

A. Section 1-05.3 Working Drawings

B. Section 1-06.1 Approval of Materials Prior to Use

C. Section 1-06.4 Handling and Storing Materials

D. WSDOT Standard Specification Sections:
   1. 2-09.3 Structure Excavation Construction Requirements
   2. 6-02.3 Concrete Construction Requirements
   3. 8-24.3 Rock and Gravity Block Wall and Gabion Cribbing Construction Requirements
   4. 9-03 Aggregates

PART 2 PRODUCTS

2.01 APPROVED ROOF STRUCTURE SYSTEMS

A. Roof structures for salt storage, and for brine maker/brine pump and street sweepings storage shall be constructed of only one of the following systems. The Contractor shall arrange to purchase the fabric, roof structure elements and all necessary incidentals from the source identified with each roof system:

1. Britespan Building Systems Inc.
   425 Orbiting Drive, Suite A
   Mosinee, WI 54455
   (800) 407-5846
   info@britespanbuldings.com
   www.britespanbuildings.com

2. ClearSpan Fabric Structures
   1395 John Fitch Blvd
   South Windsor, CT 06074
   (866) 760-1010
   www.clearspan.com

3. Portable Garage Shelter (Division of Sheltervision LLC)
   Minster, OH
   (419) 852-7765
   www.portablegarageshelter.com

2.02 MATERIALS

A. Refer to WSDOT Standard Specification Section 9-03.

B. Typical gravity block wall blocks shall be rectangular prisms with dimensions 2’-5½” by 2’-5½” by 4’-11”. Half-length blocks may to the minimum extent necessary to stack courses and

maintain vertical ends. Special blocks may be used if approved by the Engineer. All dimensions shall be ± ½ ".

Gravity block wall blocks shall be cast with Class 3000 concrete, conforming to the air content requirements of WSDOT Standard Specification Section 6-02.3(2)A. Commercial concrete shall not be used. Gravity block wall blocks will be accepted based on visual inspection, and conformance to WSDOT Standard Specification Section 6-02.3(9) and the specified concrete strength and air content requirements.

Gravity block wall blocks shall have plain, smooth surface finish.

C. Roof structures shall be of the following dimensions:
   1. Salt storage interior dimensions:
      a. Overall: 45 feet long x 30 feet wide x minimum 20 feet high roof
      b. Drive opening: 30 feet wide x 20 feet high
   2. Brine maker/brine pump and street sweepings storage interior dimensions
      a. Overall: 52 feet – 6 inches long x 20 feet wide x minimum 20 feet high roof
      b. Drive opening: 20 feet wide x 20 feet high

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Refer to Construction Requirements of WSDOT Standard Specification Section 8-24.3.

B. WSDOT Standard Specification Section 8-24.3 is supplemented with the following:
   1. After excavating for the wall base, the Contractor shall grade the excavation for a width equal to or exceeding the width of the bottom row of blocks. The base shall be graded to the base elevation shown in the Plans and working drawings as approved by the Engineer.

      The Contractor shall erect the gravity block wall and place the backfill in accordance with the erection sequence as approved by the Engineer. The top of the gravity block wall shall be within two inches of the line and grade shown in the Plans. The backfill shall be compacted in accordance with WSDOT Standard Specification Section 2-03.3(14)C, Method C.

      The Contractor shall repair all large blemishes, honeycombed areas, and chipped surfaces, (25 square inches and larger) on the exposed face of the erected wall using methods and materials as approved by the Engineer.

3.02 SUBMITTALS

A. Working drawings and submittals shall be submitted in accordance with Sections 1-05.3 and 1-06.1.

B. For the walls detailed in the Plans that are not to be designed by the Contractor, the Contractor shall submit Type 2 Working Drawings of the gravity block wall to the Engineer for approval. The working drawings shall include, but not be limited to, the following:
   1. Material approval in accordance with Section 1-06.1.
   2. Plan, elevation, and section views of the wall, showing the layout, batter, and orientation of the blocks.
   3. Dimensions and details of the blocks, including details and locations of block erection lifting loops and inserts, and the features designed to interlock blocks together if the blocks have such features.
   4. Method and equipment used to erect the blocks.
   5. Erection sequence.

   All of the above pieces of the Working Drawings shall be submitted together as a single package. Missing pieces may be grounds for rejection and pieces may not be reviewed by the Engineer separately.

C. For the walls shown in the Plans that are to be designed by the Contractor, the Contractor shall submit the following:

1. Type 2E Working Drawings of the gravity block wall to the Engineer for approval. The working drawings shall include, but not be limited to, the following:
   a. Material approval in accordance with Section 1-06.1.
   b. Plan, elevation, and section views of the wall, showing the layout, batter, and orientation of the blocks.
   c. Dimensions and details of the blocks, including details and locations of block erection lifting loops and inserts, and the features designed to interlock blocks together if the blocks have such features.
   d. Method and equipment used to erect the blocks.
   e. Erection sequence.
2. Type 2E Working Drawings of the roof structure. The Working Drawings shall include, but not be limited to, the following:
   a. Material approval in accordance with Section 1-06.1.
   b. Plan, elevation, and section views of the roof, showing overall dimensions, member materials, member sizes and shapes, connection details, and all other information necessary to construct the roof structure.
   c. For the brine maker/brine pump and street sweepings storage, provide all information necessary to attach the roof structure to the gravity block wall support.
   d. For the salt storage, provide all information necessary to attach the roof structure to the ground outside of the gravity block wall. Show the gravity block wall and indicate clearance between the roof structure and the gravity block wall.
   e. Method and equipment used to erect the blocks.
   f. Erection sequence
3. Type 2E Working Drawings of the design calculations for the gravity block walls and roof structures. The Working Drawings shall include, but not be limited to, the following:
   a. Applicable design code references. Design shall be consistent with the 2021 International Building Code, the Kitsap County Code, and the project geotechnical report
   b. Material design parameters and material specification references
   c. Design loads and load factors
   d. Member loads, capacities, resistance factors and deflections
   e. Connection calculations
   f. Wall soil bearing, sliding, and overturning / eccentricity analysis
   g. Roof foundation design calculations
   h. All other calculations necessary to cover all aspects of the gravity block wall and roof structures.

All of the above pieces of the Working Drawings shall be submitted together as a single package. Missing pieces may be grounds for rejection and pieces may not be reviewed by the Engineer separately.

D. Before physical completion of the project, the Contractor shall furnish the Engineer with an electronic set of as built shop plans. Plan size shall be no smaller than 11 by 17 inches. As-built shop plan shall be legible and clearly indicate changes to the original shop plans and the final details integrated into the project.

END OF SECTION 32 32 60

This page intentionally left blank

SECTION 32 32 61
STRUCTURAL EARTH WALLS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This Section consists of constructing structural earth walls (SEW).

1.02 DEFINITIONS

A. Structural earth walls, also known as Mechanically Stabilized Earth (MSE) Walls, are retaining wall systems, whose elements may be proprietary, that employ either metallic (strip or grid type) or geosynthetic (geotextile, strip, or geogrid) tensile reinforcements in the soil mass, and a facing element which is vertical, or near vertical.

1.03 REFERENCES

A. Section 1-05.3 Working Drawings

B. Section 1-06.1 Approval of Materials Prior to Use

C. Section 1-06.3 Manufacturer's Certificate of Compliance

D. Section 1-06.4 Handling and Storing Materials

E. WSDOT Standard Specifications Sections:
   1. 2-09.3 Structure Excavation Construction Requirements
   2. 2-12.2 Construction Geosynthetic Materials
   3. 2-12.3 Construction Geosynthetic Construction Requirements
   4. 6-02.2 Concrete Materials
   5. 6-02.3 Concrete Construction Requirements
   6. 6-13.2 Structural Earth Wall Materials
   7. 6-13.3 Structural Earth Wall Construction Requirements
   8. 9-01 Cement
   9. 9-03 Aggregates
   10. 9-04 Joint Sealing Materials
   11. 9-05.2 Underdrain Pipe
   12. 9-07 Reinforcing Steel
   13. 9-20 Concrete Patching Material, Grout, and Mortar
   14. 9-23 Concrete Curing Materials, Bonding Agents, and Admixtures
   15. 9-25 Water
   16. 9-33 Construction Geosynthetic

PART 2 PRODUCTS

2.01 APPROVED RETAINING WALL SYSTEMS

A. Structural earth walls shall be constructed of only one of the following wall systems. The Contractor shall arrange to purchase the concrete blocks, soil reinforcement, attachment devices, joint filler, and all necessary incidentals from the source identified with each wall system:
   1. Allan Block Wall
      Allan Block Wall is a registered trademark of the Allan Block Corporation

      Allan Block Corporation
      7424 W 78th Street
      Bloomington, MN 55439
      (800) 899-5309
      FAX (952) 835-0013
      www.allanblock.com

   2. GEOWALL Structural Earth Retaining Wall System
      GEOWALL is a registered trademark of Basalite Concrete Products, LLC

Basalite Concrete Products, LLC
3299 International Place
Du Pont, WA 98327-7707
(800) 964-9424
FAX (253) 964-5005
www.basalite.com

3. Redi-Rock Positive Connection System
Redi-Rock Positive Connection System is a registered trademark of Redi-Rock International, LLC

Redi-Rock International, LLC
05481 US 31 South
Charlevoix, MI 49720
(866) 222-8400
FAX (231) 237-9521
www.redi-rock.com

4. Mesa Wall
Mesa Wall is a registered trademark of Tensar Corporation

Tensar Corporation
2500 Northwinds Parkway, Suite 500
Atlanta, GA 30009
(770) 334-2090
FAX (678) 281-8546
www.tensarcorp.com

5. Landmark Retaining Wall System
Landmark Retaining Wall System is a registered trademark of Anchor Wall Systems, Inc.

Anchor Wall Systems, Inc.
5959 Baker Road, Suite 390
Minnetonka, MN 55345-5996
(877) 295-5415
FAX (952) 979-8454
www.anchorwall.com

6. KeyGrid Wall
KeyGrid is a registered trademark of Keystone Retaining Wall Systems, Inc.

Keystone Retaining Wall Systems, Inc.
4444 West 78th Street
Minneapolis, MN 55435
(800) 747-8971
FAX (952) 897-3858
www.keystonewalls.com

2.02 MATERIALS

A. Refer to WSDOT Standard Specification Section 6-13.2.

B. WSDOT Standard Specification Section 6-13.2 is supplemented with the following:
   1. Provide underdrain pipe in accordance with WSDOT Standard Specification Section 9-05.2.

2. Concrete Block Faced Structural Earth Wall Materials
   a. General Materials
      1) Concrete Block
         Acceptability of the blocks will be determined based on the following:
         (a) Visual inspection
         (b) Compressive strength tests, conforming to WSDOT Standard Specification Section 6-13.3(4).
         (c) Water absorption tests, conforming to WSDOT Standard Specification Section 6-13.3(4).
         (d) Manufacturer's Certificate of Compliance, which shall identify the manufacturer, the type and quantity of material being certified, the applicable Specifications being affirmed, and the signature of a responsible corporate official of the manufacturer and include supporting mill tests or documents. A Manufacturer's Certificate of Compliance shall be furnished with each lot of material delivered to the Work and the lot so certified shall be clearly identified in the certificate.
         (e) Freeze-thaw tests conducted on the lot of blocks produced for use in this project, as specified in WSDOT Standard Specification Section 6-13.3(4).
         (f) Copies of results from tests conducted on the lot of blocks produced for this project by the concrete block fabricator in accordance with the quality control program required by the structural earth wall manufacturer.

         The blocks shall be considered acceptable regardless of curing age when compressive test results indicate that the compressive strength conforms to the 28-day requirements, and when all other acceptability requirements specified above are met.

         Testing and inspection of dry cast concrete blocks shall conform to ASTM C 140, and shall include block fabrication plant approval by WSDOT prior to the start of block production for this project.
      2) Mortar
         Mortar shall conform to ASTM C 270, Type S, with an integral water repellent admixture as accepted by the Engineer. The amount of admixture shall be as recommended by the admixture manufacturer. To ensure uniform color, texture, and quality, all mortar mix components shall be obtained from one manufacturer for each component, and from one source and producer for each aggregate.
      3) Geosynthetic Soil Reinforcement
         Geogrid reinforcement shall conform to WSDOT Standard Specification Section 9-33.1, and shall be a product listed in Appendix D of the current WSDOT Qualified Products List (QPL). The values of T_{al} and T_{ult} as listed in the QPL for the products used shall meet or exceed the values required for the wall manufacturer's reinforcement design as specified in the structural earth wall design calculation and working drawing submittal.

         The minimum ultimate tensile strength of the geogrid shall be a minimum average roll value (the average test results for any sampled roll in a lot shall meet or exceed the values shown in Appendix D of the current WSDOT QPL). The strength shall be determined in accordance with ASTM D 6637, for multi-rib specimens.

         The ultraviolet (UV) radiation stability, in accordance with ASTM D 4355, shall be a minimum of 70 percent strength retained after 500 hours in the weatherometer.

         The longitudinal (i.e., in the direction of loading) and transverse (i.e., parallel to the wall or slope face) ribs that make up the geogrid shall be perpendicular to one another. The maximum deviation of the cross-rib from being perpendicular to the longitudinal rib (skew) shall be no more than 1 inch in 5 feet of geogrid

width. The maximum deviation of the cross-rib at any point from a line perpendicular to the longitudinal ribs located at the cross-rib (bow) shall be 0.5 inches.

The gap between the connector and the bearing surface of the connector tab cross-rib shall not exceed 0.5 inches. A maximum of 10 percent of connector tabs may have a gap between 0.3 inches and 0.5 inches. Gaps in the remaining connector tabs shall not exceed 0.3 inches.

The Engineer will take random samples of the geogrid materials at the job site. Acceptance of the geogrid materials will be based on testing of samples from each lot. A “lot” shall be defined as all geogrid rolls sent to the project site produced by the same manufacturer during a continuous period of production at the same manufacturing plant having the same product name. The Contracting Agency will require 14 calendar days maximum for testing the samples after their arrival at the WSDOT Materials Laboratory in Tumwater, WA.

The geogrid samples will be tested for conformance to the specified material properties. If the test results indicate that the geogrid lot does not meet the specified properties, the roll or rolls which were sampled will be rejected. Two additional rolls for each roll tested which failed from the lot previously tested will then be selected at random by the Engineer for sampling and retesting. If the retesting shows that any of the additional rolls tested do not meet the specified properties, the entire lot will be rejected. If the test results from all the rolls retested meet the specified properties, the entire lot minus the roll(s) which failed will be accepted.

All geogrid materials which have defects, deterioration, or damage, as determined by the Engineer, will be rejected. All rejected geogrid materials shall be replaced at no expense to the Contracting Agency.

Except as otherwise noted, geogrid identification, storage and handling shall conform to the requirements specified in WSDOT Standard Specification Section 2-12.2. The geogrid materials shall not be exposed to temperatures less than –20F and greater than 122F.

4) Drainage Geosynthetic Fabric
Drainage geosynthetic fabric shall be a non-woven geosynthetic conforming to the requirements in WSDOT Standard Specification Section 9-33.1, for Construction Geotextile for Underground Drainage, Moderate Survivability, Class B.

b. Proprietary Materials
1) Allan Block Wall
Wall backfill material placed in the open cells of the precast concrete blocks and placed in the one to three foot zone immediately behind the precast concrete blocks shall be crushed granular material conforming to WSDOT Standard Specification Section 9-03.9(3).
2) GEOWALL Structural Earth Retaining Wall System
Connection pins shall be fiberglass conforming to the requirements of Basalite Concrete Products, LLC.
3) KeyGrid Wall
KeyStone connection pins shall be fiberglass conforming to the requirements of Keystone Retaining Wall Systems, Inc.
4) Landmark Retaining Wall
Lock bars shall be made of a rigid polyvinyl chloride polymer conforming to the following requirements:

Property	Value	Specification
Specific Gravity	1.4 minimum	ASTM D 792
Tensile Strength at yield	2,700 psi minimum	ASTM D 638

Lock bars shall remain sealed in their shipping containers until placement into the wall. Lock bars exposed to direct sunlight for a period exceeding two months shall not be used for construction of the wall.

5) Mesa Wall

Block connectors for block courses with geogrid reinforcement shall be glass fiber reinforced high-density polypropylene conforming to the following minimum material specifications:

Property	Specification	Value
Polypropylene	ASTM D 4101 Group 1 Class 1 Grade 2	73 ± 2 percent
Fiberglass Content	ASTM D 2584	25 ± 3 percent
Carbon Black	ASTM D 4218	2 percent minimum
Specific Gravity	ASTM D 792	1.08 ± 0.04
Tensile Strength at yield	ASTM D 638	8,700 ± 1,450 psi
Melt Flow Rate	ASTM D 1238	0.37 ± 0.16 ounces/10 min.

Block connectors for block courses without geogrid reinforcement shall be glass fiber reinforced high-density polyethylene (HDPE) conforming to the following minimum material specifications:

Property	Specification	Value
HDPE	ASTM D 1248 Type III Class A Grade 5	68 ± 3 percent
Fiberglass Content	ASTM D 2584	30 ± 3 percent
Carbon Black	ASTM D 4218	2 percent minimum
Specific Gravity	ASTM D 792	1.16 ± 0.06
Tensile Strength at yield	ASTM D 638	8,700 ± 725 psi
Melt Flow Rate	ASTM D 1238	0.11 ± 0.07 ounces/10 min.

PART 3 EXECUTION

3.01 INSTALLATION

A. Refer to WSDOT Standard Specification Section 6-13.3.

B. WSDOT Standard Specification Section 6-13.3(5) is supplemented with the following:

1. Specific Erection Requirements for Precast Concrete Block Faced Structural Earth Walls

a. Landmark Retaining Wall

When placing each course of concrete blocks, the Contractor shall pull the blocks towards the front face of the wall until the male key of the bottom face of the upper block contacts and fits into the female key of the top face of the supporting block below.

A maximum gap of 1/8-inch is allowed between adjacent concrete blocks, except for the base course set of concrete blocks placed on the leveling pad. A maximum gap of 1-inch is allowed between adjacent base course concrete blocks, provided geosynthetic reinforcement for drains is in place over the gap at the back face of the concrete blocks.

Lock bars shall be installed in the female key of the top face of all concrete block courses receiving geogrid reinforcement. Gaps between adjacent lock bars in the key

shall not exceed 3-inches. The lock bar shall be installed flat side up, with the angled side to the back of the concrete block, as shown in the shop drawings.

Geogrid reinforcement shall be placed and connected to concrete block courses specified to receive soil reinforcement. The leading edge of the geogrid reinforcement shall be maintained within 1-inch of the front face of the supporting concrete blocks below. Geogrid panels shall be abutted for 100 percent backfill coverage with less than a 4-inch gap between adjacent panels.

Backfill shall be placed and compacted level with the top of each course of concrete blocks, and geogrid reinforcement placed and connected to concrete block courses specified to receive soil reinforcement, before the Contractor may continue placing the next course of concrete blocks.

b. Mesa Wall
For all concrete block courses receiving geogrid reinforcement, the fingers of the block connectors shall engage the geogrid reinforcement apertures, both in the connector slot in the block, and across the block core. For all concrete block courses with intermittent geogrid coverage, a #3 steel reinforcing bar shall be placed, butt end to butt end, in the top block groove, with the butt ends being placed at a center of a concrete block.

3.02 SUBMITTALS

A. Working drawings and submittals shall be submitted in accordance with Sections 1-05.3 and 1-06.1.

B. Manufacturer's Certificate of Compliance shall comply with Section 1-06.3.

C. Provide submittals in accordance with WSDOT Standard Specification Section 6-13.3(2).

D. WSDOT Standard Specification Section 6-13.3(2) is supplemented with the following:
1. All pieces of Working Drawings and Manufacturer's Certificate of Compliance shall all be submitted as a single submittal package. Missing pieces may be grounds for rejection and pieces may not be reviewed by the Engineer separately.
2. Material approval in accordance with Section 1-06.1.
3. The following geotechnical design parameters shall be used for the design of the structural earth walls:

Wall No.: 3, 4 and 5

Soil Properties	Wall Backfill	Retained Soil	Foundation Soil
Unit Weight (pcf)	130	130	130
Friction Angle (deg)	36	35	42
Cohesion (psf)	0	0	0

For the Service Limit State, the wall shall be designed to accommodate a differential settlement of 1-inch per 100 feet of wall length.

For the Extreme Event I Limit State, the wall shall be designed for a horizontal seismic acceleration coefficient k_h of 0.085g and a vertical seismic acceleration coefficient k_v of 0.0g.

E. Before physical completion of the project, the Contractor shall furnish the Engineer with an electronic set of as built shop plans. Plan size shall be no smaller than 11 by 17 inches. As-built shop plan shall be legible and clearly indicate changes to the original shop plans and the final details integrated into the project.

END OF SECTION 32 32 61

SECTION 32 32 62
SOLDIER PILE WALLS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This Section includes the construction of soldier pile walls.

1.02 DEFINITIONS

A. Soldier pile walls are a type of nongravity cantilever wall that derives lateral resistance through embedment of discrete vertical wall elements (soldier piles) and supports retained soil with facing elements (temporary timber lagging and permanent concrete fascia).

1.03 REFERENCES

A. Section 1-05.3 Working Drawings

B. Section 1-06.1 Approval of Materials Prior to Use

C. Section 1-06.3 Manufacturer's Certificate of Compliance

D. Section 1-06.4 Handling and Storing Materials

E. WSDOT Standard Specification Sections:
   1. 2-09.3 Structure Excavation Construction Requirements
   2. 6-02.2 Concrete Materials
   3. 6-02.3 Concrete Construction Requirements
   4. 6-03.2 Steel Structures Materials
   5. 6-03.3 Steel Structures Construction Requirements
   6. 6-05.2 Piling Materials
   7. 6-05.3 Piling Construction Requirements
   8. 6-16.2 Soldier Pile and Soldier Pile Tieback Walls Materials
   9. 6-16.3 Soldier Pile and Soldier Pile Tieback Walls Construction Requirements
   10. 9-01 Cement
   11. 9-03 Aggregates
   12. 9-04 Joint Sealing Materials
   13. 9-06 Structural Steel and Related Materials
   14. 9-07 Reinforcing Steel
   15. 9-08 Paints and Related Materials
   16. 9-09 Timber and Lumber
   17. 9-10 Piling
   18. 9-23 Concrete Curing Materials, Bonding Agents, and Admixtures
   19. 9-25 Water
   20. 9-33 Construction Geosynthetic

PART 2 PRODUCTS

2.01 MATERIALS

A. Refer to WSDOT Standard Specification Sections:
   1. 6-02.2 Concrete Materials
   2. 6-03.2 Steel Structures Materials
   3. 6-05.2 Piling Materials
   4. 6-16.2 Soldier Pile and Soldier Pile Tieback Walls Materials
   5. 9-01 Cement
   6. 9-03 Aggregates
   7. 9-04 Joint Sealing Materials
   8. 9-06 Structural Steel and Related Materials
   9. 9-07 Reinforcing Steel
   10. 9-08 Paints and Related Materials
   11. 9-09 Timber and Lumber
   12. 9-10 Piling
   13. 9-23 Concrete Curing Materials, Bonding Agents, and Admixtures

14. 9-25 Water
15. 9-33 Construction Geosynthetic

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Refer to WSDOT Standard Specification Section 6-16.3.

B. WSDOT Standard Specification Section 6-16.3(1) is supplemented with the following:
   1. Welding procedures shall be included in the single submittal package indicated below in 3.02.B.1.
   2. WSDOT Standard Specification Section 6-03.3(25) as referenced in this section is modified as follows:
      a. The last paragraph, beginning with “After the Contractor’s welding inspection is complete” is removed and replaced with “The Contractor shall perform ultrasonic welding inspection as detailed in 6-03.3(25)A3.”
      b. WSDOT Standard Specification Section 6-03.3(25)A is supplemented with the following:
         1) The Contractor shall be responsible for all welding inspection and testing performed in both the shop and in the field.

C. WSDOT Standard Specification Section 6-16.3(8) is supplemented with the following:
   1. The surface finish shall be produced with form liners in accordance with WSDOT Standard Specification Section 6-02.3(14)D. The first sentence of WSDOT Standard Specification 6-02.3(14)D shall be replaced with the following: “The concrete finishes listed in the table below shall be accomplished by the use of either a form liner selected from the products listed in the WSDOT Qualified Products List (QPL), or a form liner accepted by the Engineer.” Concrete finish shall be Variable Depth Random Board Finish with boards oriented horizontally. Form liners shall be placed such that vertical joints between liners are randomized and follow ends for boards.
   2. Pigmented sealer shall be constructed in accordance with WSDOT Standard Specification Section 6-02.3(14)C. The last sentence of WSDOT Standard Specification Section 6-02.3(14)C shall be replaced with the following: “If the pigmented sealer material is not listed in the current WSDOT QPL, a sample shall be submitted to the Engineer for acceptance in accordance with WSDOT Standard Specification Section 9-08.3. The color of the pigmented sealer shall be Washington Gray.

3.02 SUBMITTALS

A. Working drawings and submittals shall be submitted in accordance with Sections 1-05.3 and 1-06.1.

B. Refer to WSDOT Standard Specification Section 6-16.3(2).

C. WSDOT Standard Specification Section 6-16.3(2) is supplemented with the following:
   1. Working Drawings indicated for soldier pile walls in WSDOT Standard Specification Section 6-16.3(2) and supplemented herein shall be submitted together as a single submittal package. Missing pieces will be grounds for rejection and pieces will not be reviewed by the Engineer separately.
   2. In addition to the requirements of WSDOT Standard Specification Section 6-16.3(2), the following shall be included in the single submittal package.
      a. Material approval in accordance with Section 1-06.1.
      b. Working Drawings for pigmented sealer specified in WSDOT Standard Specification Section 6-02.3(14)C and supplemented in Section 3.01 above.
      c. Working Drawings for form liners specified in WSDOT Standard Specification Section 6-02.3(14)D and supplemented in Section 3.01 above.
      d. Working Drawings for lagging design details and supporting design calculations specified in WSDOT Standard Specification Section 6-16.3(6)B.
      e. Welding procedures specified in WSDOT Standard Specification Section 6-03.3(25).
      f. A welding inspection and testing plan. The plan shall include the following consistent with the requirements of WSDOT Standard Specification 6-03.3(25):
         1) Sequence of welding, weld inspection and weld testing

2) Location and type of welds to be inspected and tested
3) Type of weld inspection
4) Percentage of each weld, weld type, and weld inspection to be performed.

g. Type 2 Working Drawing per 6-03.3(7) for structural steel, including soldier piles.
h. Type 2E Working Drawings per 6-02.3(16) and 6-02.3(17) for forming plans for concrete fascia panels.
i. Type 2 Working Drawings for shaft installation plan.

3. Weld inspection and testing records specified in WSDOT Standard Specification Section 6-03.3(25) and supplemented above in Section 3.01B. In-progress records shall be supplied to the Engineer upon request. Complete final records shall be submitted no later than two (2) working days after completion of welds.
4. WSDOT Standard Specification Section 6-03.3(7) as referenced in this section is modified as follows:
   a. Remove the last paragraph beginning with “Before physical completion of the project, …” and replace it with “Before physical completion of the project, the Contractor shall furnish the Engineer with an electronic set of as built shop plans. Plan size shall be no smaller than 11 by 17 inches. As-built shop plan shall be legible and clearly indicate changes to the original shop plans and the final details integrated into the project.”

END OF SECTION 32 32 62

This page intentionally left blank

SECTION 32 39 40
SANDER INSERT RACK

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This Section includes the construction of the Sander Insert Rack shown in the Plans.

1.02 DEFINITIONS

A. The Sander Insert Rack is a steel structure with welded and bolted connections supported by reinforced concrete spread footings and attached to the footings with steel anchor bolts as detailed in the Plans.

B. Catwalk, stairs, and railings, including connection to the Sander Rack, shown in the Plans are not fully engineered and shall be included in the Sander Insert Rack and shall be Contractor deferred submittals.

1.03 REFERENCES

A. Section 1-05.3 Working Drawings

B. Section 1-06.1 Approval of Materials Prior to Use

C. Section 1-06.3 Manufacturer's Certificate of Compliance

D. Section 1-06.4 Handling and Storing Materials

E. WSDOT Standard Specification Sections:
   1. 2-09.3 Structure Excavation Construction Requirements
   2. 6-02.2 Concrete Materials
   3. 6-02.3 Concrete Construction Requirements
   4. 6-03.2 Steel Structures Materials
   5. 6-03.3 Steel Structures Construction Requirements
   6. 6-06.2 Bridge Railing Materials
   7. 6-06.3 Bridge Railing Construction Requirements
   8. 6-07.2 Painting Materials
   9. 6-07.3 Painting Construction Requirements
   10. 9-01 Cement
   11. 9-03 Aggregates
   12. 9-06 Structural Steel and Related Materials
   13. 9-07 Reinforcing Steel
   14. 9-08 Paints and Related Materials
   15. 9-20 Concrete Patching Material, Grout, and Mortar
   16. 9-23 Concrete Curing Materials, Bonding Agents, and Admixtures
   17. 9-25 Water

PART 2 PRODUCTS

2.01 MATERIALS

A. Refer to WSDOT Standard Specification Sections:
   1. 6-02.2 Concrete Materials
   2. 6-03.2 Steel Structures Materials
   3. 6-07.2 Painting Materials
   4. 9-01 Cement
   5. 9-03 Aggregates
   6. 9-06 Structural Steel and Related Materials
   7. 9-07 Reinforcing Steel
   8. 9-08 Paints and Related Materials
   9. 9-20 Concrete Patching Material, Grout, and Mortar
   10. 9-23 Concrete Curing Materials, Bonding Agents, and Admixtures
   11. 9-25 Water

B. WSDOT Standard Specification Section 6-02.3 is supplemented with the following:

1. Resin Bonded Anchors
   The resin bonded anchor system shall include the nut, washer, and threaded anchor rod which is installed into hardened concrete with a resin bonding material.

   Resin bonding material used in overhead and horizontal application shall be specifically recommended by the resin manufacturer for those applications.

   Resin bonding material used in submerged liquid environment shall be specifically recommended by the resin manufacturer for this application.

   The resin bonded anchor system shall conform to the following requirements:

   a. Threaded Anchor Rod and Nuts
      Threaded anchor rods shall conform to ASTM A 193 Grade B7 or ASTM A 449, except as otherwise noted, and be fully threaded. Threaded anchor rods for stainless steel resin bonded anchor systems shall conform to ASTM F 593 and shall be Type 304 unless otherwise specified.

      Nuts shall conform to ASTM A 563, Grade DH, except as otherwise noted. Nuts for stainless steel resin bonded anchor systems shall conform to ASTM F 594 and shall be Type 304 unless otherwise specified.

      Washers shall conform to ASTM F 436 and shall meet the same requirements as the supplied anchor rod, except as otherwise noted. Washers for stainless steel resin bonded anchor systems shall conform to ASTM A 240 and the geometric requirements of ASME B18.21.1 and shall be Type 304 Stainless Steel unless otherwise specified.

      Nuts and threaded anchor rods, except those manufactured of stainless steel, shall be galvanized in accordance with AASHTO M 232. Galvanized threaded anchor rods shall be tested for embrittlement after galvanizing, in accordance with WSDOT Standard Specification Section 9-29.6(5).

      Threaded anchor rods used with resin capsules shall have the tip of the rod chiseled in accordance with the resin capsule manufacturer's recommendations. Galvanized threaded rods shall have the tip chiseled prior to galvanizing.

   b. Resin Bonding Material
      Resin bonding material shall be a two-component epoxy resin conforming to Type IV ASTM C 881 or be one of the following:
      1) Vinyl ester resin.
      2) Polyester resin.
      3) Methacrylate resin.

   c. Ultimate Anchor Tensile Capacity
      Resin bonded anchors shall be tested in accordance with ASTM E 488 to have the following minimum ultimate tensile load capacity when installed in concrete having a maximum compressive strength of 6000 pounds per square inch (psi) at the embedment specified below:

Anchor Diameter (inch)	Tensile Capacity (lbs.)	Embedment (inch)
3/8	7,800	3-3/8
1/2	12,400	4-1/2
5/8	19,000	5-5/8
3/4	27,200	6-3/4
7/8	32,000	7-7/8
1	41,000	9
1-1/4	70,000	11-1/4

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Refer to WSDOT Standard Specification Sections 2-09.3, 6-02.3(18), 6-03.3(14), 6-03.3(30), 6-03.3(33), 6-03.3(35), 6-03.3(36), 6-07.3, 9-06.2, 9-06.3, 9-06.5(3), and 9-20.3(2).

B. WSDOT Standard Specification Section 2-09.3 is supplemented with the following:
   1. WSDOT Standard Specification Section 2-09.3(1)C is supplemented with the following:
      a. If the soil in the footing excavation for the Sander Insert Rack is disturbed and becomes unsuitable before placement of the concrete footing, the Contractor shall excavate below the plan grade a maximum of 1 foot, as determined by the Engineer, and backfill with gravel backfill for foundations.
   2. WSDOT Standard Specification Section 2-09.3(2) is supplemented with the following:
      a. Excavation and shoring or extra excavation for the Sander Insert Rack shall be considered Class A.
   3. WSDOT Standard Specification Section 2-09.3(3)B is modified as follows:
      a. The fourth paragraph after the first numbered list, beginning with “The Contractor may omit forms when…” is replaced with the following:
      The Contractor may not omit forms inside excavations and shall not pour concrete against earthen sides of excavations. All concrete shall be formed.

C. WSDOT Standard Specification Section 6-02.3 is modified as follows:
   1. WSDOT Standard Specification Section 6-02.3 is modified as follows:
      a. References to concrete testes by the “Contracting Agency” shall be replaced with concrete tests by the “Contractor”. The Contractor shall, at the cost to the Contractor, hire a third party concrete testing company to perform required tests, including temperature, slump, air content for concrete placed above finished ground (including full height of Sander Insert Rack footing pedestals), and the specified compressive strength at 28 days. Scheduling testing services to be provided for concrete pours shall be coordinated by the Contractor. Concrete shall not be poured without testing.
   2. WSDOT Standard Specification Section 6-02.3(5) is supplemented with the following:
      a. Additional test cylinders for early removal of forms, early backfill, early loading of concrete, or any other reason the Contractor may require are at the sole discretion of the Contractor. Early removal of forms, early backfill of footings and early loading of footings will not be approved without cylinder test results, except as approved in WSDOT Standard Specification Sections 2-09.3(1)E and 6-02.3(17)N.
      b. Acceptance for concrete in Sander Insert Rack footings will not be accepted based on core method.
   3. WSDOT Standard Specification Section 6-02.3(14)C is supplemented with the following:
      The color of the pigmented sealer shall be Washington Gray.
   4. WSDOT Standard Specification Section 6-02.3(18) is supplemented with the following:
      Resin Bonded Anchors:
      The embedment depth of the anchors shall be as specified in the Plans. If the embedment depth of the anchor is not specified in the Plans then the embedment depth shall be as specified in the table of minimum and maximum torque below.

The anchors shall be installed in accordance with the resin manufacturer's written procedure.

Holes shall be drilled as specified in the Plans. Holes may be drilled with a rotary hammer drill when core drilling is not specified in the Plans. If holes are core drilled, the sides of the holes shall be roughened with a rotary hammer drill after core drilling.

Holes shall be prepared in accordance with the resin manufacturer's recommendations and shall meet the minimum requirements as specified herein. Holes drilled into concrete shall be thoroughly cleaned of debris, dust, and laitance prior to installing the threaded rod and resin bonding material. Holes shall not have any standing liquid at the time of installation of the threaded anchor rod.

The anchor nuts shall be tightened to the following torques when the embedment equals or exceeds the minimum embedment specified.

Anchor Diameter (inch)	Minimum Torque (ft-lbs)	Minimum Torque (ft-lbs)	Minimum Embedment (inch)
3/8	12	18	3-3/8
1/2	22	35	4-1/2
5/8	55	80	5-5/8
3/4	106	140	6-3/4
7/8	165	190	7-7/8
1	195	225	9
1-1/4	370	525	11-1/4

When the anchor embedment depth is less than the minimum values specified, the anchor nuts shall be tightened to the torque values specified in the Plans, or as recommended by the resin bonded anchor system manufacturer and approved by the Engineer.

D. WSDOT Standard Specification Section 6-03.3 is supplemented with the following:
   1. WSDOT Standard Specification Section 6-03.3(28)B is supplemented with the following: If an assembly or stage of assembly is not accepted by the Engineer, deficiencies shall be corrected and the assembly or stage of assembly shall be resubmitted to the Engineer for acceptance.
   2. WSDOT Standard Specification Section 6-03.3(30) is supplemented with the following: Paint for the new steel shall be applied in accordance with WSDOT Standard Specification 6-07.3(9). The color of the top coat, whey dry, shall match federal color number AMS-STD 595A 13591 (OSHA Safety Yellow).

3.02 SUBMITTALS

A. Working drawings and submittals shall be submitted in accordance with Sections 1-05.3 and 1-06.1.

B. Manufacturer’s Certificate of Compliance shall comply with Section 1-06.3.

C. The Sander Insert Rack construction submittal shall be a single submittal package to include all required submittal pieces, Working Drawings, materials approval, and Certificates of Compliance as specified in Sections 1-06.1 and 1-06.3, and WSDOT Standard Specification Sections 2-09.3, 6-02.3, 6-03.3, 6-06.3, and 6-07.3 applicable to the pieces of work for construction that require approval prior to construction of the Sander Insert Rack. Catwalk, stairs, and railing shown in the Plans are not fully engineered. The single submittal package shall include Type 2E Working Drawings and calculations for design and construction of the catwalks, stairs, railing, and connection to the Sander Rack; including dimensions necessary for fabrication and construction, details for fabrication and construction, materials, member loading and capacities, references to applicable building codes and OSHA requirements. Missing pieces may be grounds for rejection and separate pieces may not be reviewed separately.

Additional submittals required for pieces of the work that are specified to be submitted during construction of the Sander Insert Rack may be submitted separately.

D. WSDOT Standard Specification 6-02.3 is supplemented with the following:

1. Resin Bonded Anchor information shall be included in the single submittal package indicated in 3.02.C.1:

   The Contractor shall submit items 1 and 2 below to the Engineer for all resin bonded anchor systems. If the resin bonded anchor system and anchor diameter are not listed in the current WSDOT Qualified Products List, the Contractor shall also submit item 3 below to the Engineer.

   For resin bonded anchor systems that are installed in a submerged liquid environment the Contractor shall submit items 1, 2, and 4 below. If the resin bonded anchor system and anchor diameter are not listed in the current WSDOT Qualified Products List, the Contractor shall also submit item 3 below to the Engineer.

   1) The resin manufacturer's written installation procedure for the anchors.
   2) The manufacturer's certificate of compliance for the threaded anchor rod certifying that the anchor rod meets these requirements.
   3) Test results by an independent laboratory certifying that the threaded anchor rod system meets the ultimate anchor tensile load capacity specified in the above table. The tests shall be performed in accordance with ASTM E 488.

   For threaded anchors intended to be installed in submerged liquid environments the Contractor shall submit tests performed by an independent laboratory within the past 24 months which certifies that anchors installed in a submerged environment meet the strength requirements specified in the above table.

2. WSDOT Standard Specification Section 6-02.3(16) is modified as follows:
   The first paragraph of this section is replaced with the following:
   The Contractor shall submit all plans for falsework and formwork as Type 2E Working Drawings.

3. Before physical completion of the project, the Contractor shall furnish the Engineer with an electronic set of as built shop plans. Plan size shall be no smaller than 11 by 17 inches. As-built shop plan shall be legible and clearly indicate changes to the original shop plans and the final details integrated into the project.

END OF SECTION 32 39 40

This page intentionally left blank

SECTION 32 84 00
IRRIGATION

PART 1 GENERAL

1.01 SCOPE

A. This Section specifies all work Contractor shall provide for construction of irrigation systems including furnishing all labor, materials, equipment and services necessary for a functional irrigation system as shown on the Drawings and specified herein. Contractor shall be responsible for protecting existing plant material and re-seeding areas disturbed by construction processes as a part of this work.

1.02 SYSTEM PERFORMANCE REQUIREMENTS

A. Layout of the system as shown on drawings is schematic. Follow as closely as possible. Modify locations as required by plant materials, utilities and other obstructions.

B. Full and complete head to head irrigation coverage is required. Make adjustments to layout, irrigation zone pressure, or as needed, to achieve full coverage of irrigated areas without overspray onto roadways, sidewalks or buildings.

C. Obtain and pay for all permits, approvals and inspections required by the local jurisdictional authorities for the full operation on the system.

D. Contractor shall coordinate all irrigation work with other trades. This includes but is not limited to: location and electrical point of connection at the irrigation controller, irrigation sleeving through walls and under pavement, irrigation water meter installation.

E. Contractors must be Washington State Licensed landscape contractor with at least three years of experience.

1.03 SUBMITTALS

A. Submit product data a minimum of 14 working days before beginning work, unless otherwise approved. Include data for all products to be installed in these systems. Include material showing manufacturer's name, catalog numbers, catalog cuts, technical data manufacturers' installation, operation and maintenance instructions for each product.

B. Point of Connection Water Pressure Test: Test water pressure at the irrigation system point of connection prior to beginning work. Submit results of test to Landscape Architect.

C. Site Inspection Report: Submit statement confirming a site inspection has been conducted, noting discrepancies between ground measures and plans, hazards or site conditions which will interfere with installation or operation of the system prior to beginning of work.

D. Record Drawings
   1. Maintain a complete set of record drawings, corrected daily, to show design and specification changes, and location of system components. Submit copies as requested.
   2. At completion, submit plans at the same scale as the construction plans, indicating the elevations of mainlines, valves, backflow preventers, zone outlines and other system elements, indicate locations with dimensions from building, curb lines or other fixed site features.

E. Submit three sets of keys, hose swivels, quick coupler operating keys, and unique tools or devices needed to access, operate, adjust or maintain the system. Obtain receipt indicating location and custodian of each set.

F. Operating and Maintenance Data:
   1. Submit the name and address of permanent service organizations maintained or trained by the manufacturers that will render service within eight hours of receipt of notification of service request.
   2. Zone Map: Submit an irrigation plan for the site indicating, by varying colors, the area of coverage for each control valve. Indicate the number and location of the valve. The number is to correspond to that on the controller for that zone.
   3. Submit controller timing schedule indicating on a weekly basis the day, time and duration of watering for each control valve.

4. Provide the zone map and controller timing schedule, folded into a plastic envelope, of a size capable of being installed in the door of the controller.
5. Submit operating and maintenance guides for the entire system and for each piece of equipment in the system. Instructions for system winterization are to be included.

1.04 QUALITY ASSURANCE

A. Comply with requirements of utility supplying water for prevention of backflow and back siphonage.

B. Comply with requirements of authority with jurisdiction for irrigation systems.

C. Installer Qualifications: Engage an experienced installer who has completed irrigation systems similar in material, design, and extent to that indicated for projects that have resulted in construction with a record of successful in-service performance.

1.05 PROJECT CONDITIONS

A. Environmental Requirements: Perform work under environmental conditions suitable for the tasks being undertaken.

B. Existing Conditions:
1. Visit the site and note conditions which affect work under this Section.
2. Locate all utilities, subsurface drain lines at ball fields, and piping in the work area. Provide adequate protection during all phases of work.
3. Repair utilities, lines, drain lines, and piping damaged by this work to the satisfaction of the Owner of the line, at no change in Contract Price.
4. Notify the Contracting Agency of unsatisfactory conditions. Proceed with work only after conditions have been corrected.
5. Field Measurements: Take field measurements of irrigated areas to determine if differences occur between plans and ground dimensions. Notify Landscape Architect of differences before proceeding with work.
6. Irrigation is not permitted during the following conditions:
   a. When the temperature is less than 35 degrees F or greater than 90 degrees F.
   b. When the planting area's soil is saturated, frozen, or dry.
   c. When wind velocities are greater than 30 mph.

1.06 SEQUENCING AND SCHEDULING

A. Installation of this irrigation system will be occurring around existing trees. Contractor shall take care to avoid damage to existing tree roots during the installation of the irrigation system.

B. Thirty days prior to beginning work, submit a work schedule to include: dates, location, and type of work to be performed.

1.07 SYSTEM PROTECTION

A. As a part of the warranty under this contract, the contractor is responsible for deactivating and draining the system prior to the onset of the freezing season and for reactivating the system at the onset of spring irrigation season. Each event must be accomplished at least once during the one year warranty.

B. The contractor shall submit a letter to the Owner certifying that the system was winterized and drained, and indicate the date such action was accomplished.

C. The Contractor shall be responsible for any damage resulting from failure to comply.

1.08 SYSTEM FAMILIARIZATION

A. Before final acceptance of the system, the contractor shall provide the necessary keys and/or other tools necessary to operate, drain and activate the system and shall spend sufficient time the Owner to insure that the system operation, maintenance, and winterization can continue after the departure of the Contractor.

B. Tools and Keys
1. Provide three (3) complete sets of tools and keys to Owner (i.e., water keys, quick coupler keys, valve cover keys, and controller keys.

C. Maintenance Manuals: The Contractor shall provide two (2) operation and maintenance manuals. The manuals shall be indexed and tabbed, bound in hardback 3-ring binders. Include the following items/information:
   1. List of authorized distributors and service representatives (in the area), for each item of irrigation equipment: Including websites, Names, email address, and phone numbers.
   2. Guarantee /warranty certificates for all equipment used and Contractors written warranty for entire system (1) year guarantee.
   3. Manufacturer's maintenance sheets, replacement parts list and equipment brochures for all equipment used.
   4. Winterization and spring startup procedures.
   5. A pocket for one copy of the record drawings. This plan shall be added at the time of final inspection.

1.09 WARRANTY

A. Refer to the General and Supplementary General Conditions.

B. Provide comprehensive Two-year irrigation warranty beginning from Date of Substantial Completion to cover all maintenance services and replacement parts.

C. Additional Requirements:
   1. Repair settling of trenches. Include complete restoration of plantings, mulch, grades, pavements or other improvements.
   2. Correct irrigation system problems or damage within five working days of notice until fulfillment of the Two-year irrigation warranty period.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. As shown on the Drawings or specified herein. Alternate materials will be acceptable if approved in writing by Owner.

B. Other Manufacturers: Submit substitution request in accordance with the requirements of the General Conditions.

2.02 MATERIALS

A. Mainline (pressure pipe): All irrigation mainlines shall be Schedule 40, (IPS Plastic Pipe) pipe as indicated on drawings. The pipe shall conform to commercial standards ASTM 1785. Pipe shall be marked with manufacturer's name, class of pipe and NSF seal. Pipe walls shall be uniform and shiny. Pipe and fittings must be non-toxic, free from taste and odor and self-extinguishing and conform to the following minimums:
   1. Tensile strength 78°F 6000psi
   2. Izod impact strength (notices) 15 ft. lb./in.
   3. Modulus of elasticity 300,000 psi
   4. Compressive strength 8,500 psi
   5. Flexural strength 10,500 psi

B. Lines under paved areas shall be PVC Schedule 40 conforming to standards of ASTM 1785.

C. Lateral Pipe (circuit/zone pipe): Schedule 40 PVC, (IPS Plastic Pipe) pipe as indicated on drawings. The pipe shall conform to commercial standards ASTM D 2241.

D. Poly pipe and fittings shall be thick walled polyethylene pipe specifically designed for connection of irrigation heads to lateral lines.

E. Sleeves: Irrigation sleeves shall be Schedule 40 PVC conforming to standards of ASTM D 1785, minimum 4″.

F. Pipe Fittings:
   1. All PVC pipe fittings shall be solvent weld type except where swing joints, risers, etc., require threaded fittings. All pipe fittings shall conform to standards of ASTM D 2466 (Schedule 80).

G. Jointing Materials:

1. PVC solvent cement, NSF61 approved solvent for PVC through 4-inch, meeting requirements of ASTM D2564.
2. PVC primer and cleaner, compatible for use with PVC pipe.
3. Teflon tape sealer, 3/4 or 1/2-inch wide, or Teflon Dope, shall be used at all threaded joints as needed.

H. Valves:
1. Automatic Valves: Contamination resistant, plastic, flow control, manual bleed. 24 volt, normally closed, solenoid operated, with 150 psi CWP rating, having IPS threads and suitable for underground burial. Manufacturer's limited warranty of not less than (5) years. Acceptable Manufactures: Hunter, Rain Bird, or approved equal.
2. Manual drain valves shall be the non-lubricated type, capable of sealing in either flow direction, with true union end connections and lever type operator. PVC ball valves shall be constructed using a PVC body and ball, Teflon seats and FPM (viton) o-rings. Provide PVC ball valves from Asahi America, Chemtrol Division, NIBCO Inc., or approved equivalent.

I. Valve Boxes:
1. For Control Valves: Locking plastic – by NDS (National Drainage Systems, Camarillo, CA) or approved equivalent with flange type lid on box.
2. For backflow preventers: Locking concrete vault per plan.
3. For manual drain valves: Locking plastic – per plan.
4. For all quick-couplers: Round valve boxes – per plan.

J. Backflow Preventer: Double check type, per plan. Acceptable Manufacturers:
1. Febco
2. Zurn-Wilkins
3. Watts
4. Or approved equal.

K. Automatic Controller: Interior wall mount with wireless Solar Sync Sensor and Solar Sync Receiver per plan. Acceptable Manufacturers:
1. Hunter
2. Rain Bird
3. Or approved equal.

L. Spray and Rotary Heads: Acceptable Manufacturers:
1. Rain Bird
2. Hunter
3. Toro
4. Or approved equal.

M. Drip Irrigation: Acceptable Manufacturers:
1. Rain Bird
2. Hunter
3. Toro
4. Or approved equal.

N. Quick Couplers: Quick couplers shall be per plan

O. Master Valve / Flow Sensor shall be per plan.

P. Low Voltage Control Wire and Connectors:
1. All buried control wire must be insulated copper designed for 24 volts or higher. Minimum size of wire is AWG#14. Common wire shall be of the same size or larger than control wire. Control wire shall be red, common wire shall be white. Size of longer wire runs requiring gauges larger than AWG#14 shall be sized according to electric valve manufacturer's recommendation and irrigation controller's recommendation.
2. To facilitate easier connection to controller terminals, AWG#14 wire may be connected to AWG#18 multi-strand irrigation wire within 6 feet of field controller and actual connection to field controller made with AWG#18.

Q. Other Materials

1. Drain Rock: Washed, round river pea gravel, no fines.
2. Trench Backfill: Masons sand and excavated soil as specified, or shown on drawings.
3. Tracing Wire: The wire shall be yellow insulated copper wire size AWG#12.
4. Swing Joints: Hunter SJ Swing Joint.
5. Valve Keys: 3 feet long (minimum) with tee handle and key end to fit manual valves.

R. Provide other materials, not specifically described but required for a complete and proper installation, as selected by Contractor subject to the approval of Owner.

PART 3 EXECUTION

3.01 EXAMINATION

A. Investigate and determine available water supply pressure and flow characteristics. Report results of pressure test at point of connection to Landscape Architect before beginning installation work.

B. Prior to beginning work, carefully inspect the preparatory work of other trades and verify that such work is acceptable for the installation of this work. Report all unacceptable conditions to Owner. Do not begin work until unacceptable conditions have been resolved. Beginning work constitutes Contractor acceptance of conditions.

3.02 PROTECTION

A. Provide protection for system components at all times. Keep rock, gravel, debris, and all other foreign materials from entering piping, valves and other equipment.

B. Provide barriers, crossings, markers and other devices necessary to protect materials and pedestrians at open trenches, holes, stockpiles, etc.

3.03 INSTALLATION

A. Layout:
1. Layout all work in accordance with plans and details as shown on the drawings.
2. Locate irrigation apparatuses, equipment, etc., in planting areas wherever possible.
3. If minor changes in locations are required due to field conditions, work shall be accomplished by the Contractor at no additional cost to the Owner provided such field adjustments changes require no significant amount of additional irrigation equipment.

B. Trenches:
1. Excavate trench bottoms with uniform slopes, 4″ minimum width. Bottoms shall be smooth and free of rocks or other objects which might damage pipe.
2. Make trenches wide enough to allow for tamping around pipe.
3. Excavate trenches to a depth allowing for pipe slopes to drains, sand setting bed and the following minimum coverage depths:
   a. Pressure Laterals: 12 inch depth minimum.
   b. Pressure Mainlines: 18 inch depth minimum.
   c. Pressure Mainlines Under Paving: 24 inch depth minimum.
   d. Common and Control Wire: Install below mainlines or 18 inches where wire is not in a pipe trench.
4. Do not lay pipe on unstable materials in wet trench or when trench or other conditions are unsuitable.

C. Pipe and fittings:
1. Lay pipe and make connections in accordance with irrigation industry standard practices and manufacturer’s recommendations.
2. Solvent weld all non-threaded joints. Use Teflon tape or Teflon Dope to seal threaded joints as needed. Do not weld in temperatures below 35° F.
3. Slope pipe at 1/2 percent minimum toward drain valves.
4. Clean interior of pipe before installation. Keep pipe clean during and after laying by plugs or other means.
5. No fittings are to be closer than 6″ apart.
6. Set lines 6 inches apart in common trenches whenever possible, side by side, two lines maximum per trench.
7. Where possible, install PVC lines and Valves adjacent to hardscapes in planting areas.

8. Manual drain valves shall be installed at all low points of the irrigation system. A two cubic-foot gravel sump shall be installed at each drain valve.
9. Cut PVC pipe ends at 90 degrees to the pipe length and clean all cutting burrs prior to cementing. Wipe pipe ends clean. Apply primer to both fitting and pipe end. Apply a light coat of cement on the inside of the fitting, and a heavier coat on the outside of the pipe. Insert pipe into fitting and give a quarter turn to set the cement. Wipe excess cement from the outside of the pipe. Test pipe as indicated elsewhere in these specifications. Backfill the center of the pipe lengths until the pressure test is complete.
10. Cure all welded joints at least 15 minutes before moving and 24 hours before water is permitted in the pipe.

D. Sleeves:
1. Install sleeves in all locations where piping and control wiring pass under paved areas and curbs or through walls. Extend sleeve 12 inches beyond edge of paving, curb, or wall. Cap and mark the location with temporary 2″ x 4″ fir stake, 18 inches above grade. Remove stake once pipe and wires have been routed through sleeves and sleeve has been permanently marked by Owner.
2. Set top of sleeve 18-inch minimum (24″ at road crossings) below top of sub-grade below paved, mulched, graveled or other surfaces. Fill (3) inches below, around and above pipe, to top of trench with masons sand. Compact to density required for pavement subgrade.

E. Backfill:
1. Pressure tests shall be observed and approved by the Owner. Backfill trenches after inspection of pressure test as part of the work of this Section.
2. Backfill with the excavated materials approved , consisting of earth, loam, sandy clay, sand or other materials free from stones 1-1/2″ or larger.
3. Tamp trenches to adequately prevent sunken areas due to settlement.
4. Mechanically compact trenches under hardscape in (2) lifts to a dry density equal to 90% of adjacent undisturbed soil.
5. Backfill must conform to adjacent grades without dips, sunken areas, humps, or other surface irregularities.
6. Fill piping with water at approximately 25 psi during backfilling operations.
7. Remove all excess excavated material from the project site.

F. Double Check Valve Assembly:
1. Install in accordance with local code.
2. Use brass manifold for backflow preventer. Include a capped ¾″ blow out tee for quick coupler valve for winterization purposes. Install with test cocks turned to the side to promote drainage during winterization.
3. Provide 6″ of 5/8″ washed gravel at the bottom of the valve box. Provide positive drainage out of the valve box.
4. Double check valve assembly must be tested by a state certified inspector following inspection.

G. Control Wire:
1. Route red control and white common wires from controller to control valves and make connections at each end.
2. Tape control wires together at 10-foot intervals. Provide 24″ expansion loop every 100 feet of wire. Allow 24″ of extra wire at controller and each valve.
3. Splice only at the valves, not between valves or between valve and controller.
4. Route wire below main line wherever possible. Where not routed below mainline, install 4-6 inch wide yellow plastic warning tape 6 inches above the control wire.

H. Automatic Control Valves:
1. Install complete with valve boxes as shown on drawings, no closer than 12″ apart.
2. Thoroughly flush supply lines before installing valves.
3. Install one ball valve/union upstream of the valve in manifold.
4. Use valve box extensions to ensure that box extends 5″ below the bottom of the valve.
5. Leave valve pit with a clean layer of 5/8″ gravel in the bottom of the valve box with 4″ clearance (min.) between gravel and bottom of valve.

I. Master Valve and Flow Sensor:
   1. Install complete master valve and flow Sensor system in valve boxes as shown on drawings.
   2. Flow sensor and master valve shall be direct wired to controller and calibrated to prevent system from running in the event that there is a leak or broken component.
   3. Thoroughly flush supply lines before installing valves.
   4. Install one ball valve/union upstream of the master valve in manifold.
   5. Use valve box extensions to ensure that box extends 5″ below the bottom of the valve.
   6. Leave valve pit with a clean layer of 5/8″ gravel in the bottom of the valve box with 4″ clearance (min.) between gravel and bottom of valve.

J. Irrigation Heads:
   1. Install as shown on drawings and as recommended by manufacturers.
   2. No head shall be closer than 3″ from walk, curb or wall.
   3. Make minor changes in head location as necessary to achieve full head to head coverage. Adjust spray patterns and pressure to achieve coverage and eliminate over-spray onto pavements or buildings.
   4. Flush line before installing irrigation heads.
   5. All irrigation heads must be accessible for adjustment.

K. Tracing wire:
   1. Tracer wire shall be installed on all nonmetallic pipe. All nonmetallic pipe includes all irrigation main lines and laterals. The tracer wire shall be fastened to the top of all nonmetallic pipe at intervals not more than 4 feet on center. The wire shall be long enough to head out of each valve box to finish grade plus two feet. Tracer wires that terminate at the last irrigation head on a lateral shall include six complete wraps around the last irrigation head. Fasten wire to all elbows and bends.

3.04 FIELD QUALITY CONTROL

A. Testing:
   1. Notify Landscape Architect in writing at least three work days prior to all tests and inspections. Inspection reports must be made for all tests.
   2. Thoroughly flush piping before testing and installation of sprinklers.
   3. Hydrostatically test all exposed mainline piping, valves, joints and fittings at 100 psi for one hour prior to inspection by Landscape Architect. If pressure loss occurs, inspect the entire system, make watertight and retest until no pressure loss occurs for a one-hour testing period.
   4. Pressure test must show no pressure loss for the specified period and be approved by the Landscape Architect before backfill of trenches will be allowed.

B. Inspection: Upon completion of the installation and adjusting of the irrigation system, notify the Landscape Architect for a system inspection. At that time, present the following:
   1. Zone by zone system demonstration.
   2. Location of major system components.
   3. Winterization and maintenance procedures.
   4. Procedures for setting the controller, Solar Sync device and master valve/flow sensor.
   5. Location of Zone Map and Controller Schedule.

3.05 ADJUSTING AND TIMING

A. Adjust and balance irrigation system to provide uniform coverage and prevent overspray onto pavements and structures.

B. Set timing on irrigation controller before final inspection. Obtain recommendations of landscaping work installer before setting timing.

3.06 CLEAN UP

A. Area shall be kept free of debris during the course of this project.

B. Remove all debris, dirt, rock, etc. Sweep roadways and wash walls upon completion of work daily.

C. Clean all glue spills off hardscapes, etc.

END OF SECTION 32 84 00

SECTION 32 90 00
PLANTING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Trees.
   2. Shrubs.
   3. Ground cover.
   4. Tree stabilization.
   5. Topsoil
   6. Soil amendments
   7. Mulches
   8. Fertilizer
   9. Tree staking

B. All planting work shall be in accordance with the Kitsap County Code.

1.02 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than sizes indicated; wrapped, tied, rigidly supported, and drum laced as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than sizes indicated.

D. Bare-Root Stock: Exterior plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of exterior plant required.

E. Clump: Where three or more young trees were planted in a group and have grown together as a single tree having three or more main stems or trunks.

F. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of exterior plant required.

G. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of exterior plant.

H. Finish Grade: Elevation of finished surface of planting soil in seeded areas or mulch in plant beds.

I. Multi-Stem: Where three or more main stems arise from the ground from a single root crown or at a point right above the root crown.

J. Planting Soil Mix: Imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for pant growth.

K. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

L. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each of the following:
   1. 5 lb (2.2 kg) of mulch for each color and texture, in labeled plastic bags.

2. Soil mix, in labeled plastic bags.

C. Qualification Data: For qualified landscape Installer.

D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
   1. Manufacturer's certified analysis for standard products.
   2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

E. Material Test Reports: For existing surface soil and imported topsoil.

F. Planting Schedule: Indicating anticipated planting dates for exterior plants.

G. Maintenance Instructions: Landscape Maintenance Plan including procedures to be established by Owner for maintenance of exterior plants during a calendar year. Submit before expiration of required maintenance periods.

H. Warranty: Sample of special warranty.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants.
   1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Topsoil Analysis: Engage a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
   1. Report suitability of topsoil for plant growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil. No granular fertilizers shall be used.

D. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."
   1. Selection of exterior plants purchased under allowances will be made by Landscape Architect, who will tag plants at their place of growth before they are prepared for transplanting.

E. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above the ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver exterior plants freshly dug.
   1. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

B. Do not prune trees and shrubs before delivery except as approved by the Contracting Agency. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery and handling.

C. Handle planting stock by root ball.

D. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants and trees in shade, protect from weather and mechanical damage, and keep roots moist.
   1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.

2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.06 PROJECT CONDITIONS

A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed according to manufacturer's written instructions and warranty requirements.

B. Coordination with Seeding: Plant trees and shrubs after finish grades are established and before seeding unless otherwise acceptable to Landscape Architect.
   1. When planting trees and shrubs after seeding, protect seeded areas and promptly repair damage caused by planting operations.

1.07 WARRANTY

A. Special Warranty: Installer's standard form in which Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by Owner, or incidents that are beyond Contractor's control.
      b. Structural failures including plantings falling or blowing over.
      c. Faulty operation of tree stabilization tree grates.
      d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Periods from Date of Substantial Completion:
      a. Trees and Shrubs: Two year.
      b. Ground Cover and Plants: Two year.
      c. Seed Areas: Two year. Guarantee a relatively uniform, acceptable stand of grass with no bare spots over three inches square in seeded areas at time of provisional review (Punchlist). Reseed with the seed and in the manner originally specified any seeded area which fails to vigorously establish a uniform stand for any reason whatsoever. Fill to finish grade with approved topsoil and seed as specified all seeded areas which evidence settlement or erosion. Repeat all such reseeding for one year at Contractor's expense.
   3. Include the following remedial actions as a minimum:
      a. Remove dead exterior plants immediately. Replace immediately unless required to plant in the succeeding planting season.
      b. Replace exterior plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
      c. A limit of one replacement of each exterior plant will be required except for losses or replacements due to failure to comply with requirements.
      d. Provide extended warranty for replaced plant materials; warranty period equal to original warranty period.

1.08 MAINTENANCE SERVICE

A. Maintenance Service for Trees and Shrubs: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below.

B. Maintenance Period: Two years from date of planting completion.

C. Maintenance Service for Ground Cover and Plants: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below.

D. Maintenance Period: Two years from date of planting completion.

E. Maintenance Service for Seeded Areas: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below.

F. Maintenance Period: Two years from date of planting completion.

PART 2 PRODUCTS

2.01 TREE AND SHRUB MATERIAL

A. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Provide trees and shrubs of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1.

D. If formal arrangements or consecutive order of trees or shrubs is shown, select stock for uniform height and spread, and number label to assure symmetry in planting.

2.02 SHADE AND FLOWERING TREES

A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required.
   1. Provide balled and burlapped trees.
   2. Branching Height: One-third to one-half of tree height.

B. Small Spreading Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:
   1. Stem Form: Multi-stem.
   2. Provide balled and burlapped trees.

2.03 DECIDUOUS SHRUBS

A. Form and Size: Shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.
   1. Shrub sizes indicated are sizes after pruning.
   2. Provide container shrubs.

2.04 GROUND COVER PLANTS

A. Ground Cover: Provide ground cover of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.

2.05 PLANTS

A. Vines: Provide vines of species indicated complying with requirements in ANSI Z60.1 as follows:
   1. Two-year plants with heavy, well-branched tops, with not less than 3 runners 18 inches (450 mm) or more in length, and with a vigorous well-developed root system.
   2. Provide field-grown vines. Vines grown in pots or other containers of adequate size and acclimated to outside conditions will also be acceptable.

2.06 TOPSOIL

A. Existing Topsoil shall be retained from existing planting areas to the maximum extent practicable. Existing Topsoil stripped during site clearing shall be stockpiled and amended for reuse as backfill in planting areas. Amendments of existing topsoil shall be calculated based on tests of the soil and amendments and approved by the Engineer. Amended Existing Topsoil shall meet the requirements of Imported Topsoil as described below.

B. Imported Topsoil may be used to supplement Existing Topsoil as needed. Imported Topsoil shall meet the following requirements

1. Cation exchange capacity (CEC) of Topsoil shall be a minimum of 10 milliequivalents CEC/100 g dry soil (U.S. EPA Method 9081).

2. Organic content greater than 10-percent but less than 15-percent as measured on a dry weight basis using AASHTO T 267 Determination of Organic Content in Soils by Loss on Ignition.

3. pH shall be between 6.0 and 7.5.

4. Soluble salt contents shall be less than 3.0 hos/com.

5. Conductivity shall be less than 3 mmhs/cm.

Topsoil shall be 50-percent to 65-percent Sandy Loam and 50-percent to 35-percent Fine Compost by volume. Sandy Loam shall be as defined by the US Department of Agriculture Soil Classification System, meeting the requirements of Table 1; and be free of phyto-toxic materials, and viable seeds, rhizomes or roots of State-listed noxious weeds.

Table 1. Particle Size Analysis for Loam

Sieve Size	Percent Passing
3/4”	100%
1/2”	90-100%
3/8”	85-100%
#4	75-90%
#10	55-75%
#20	45-60%
#30	40-55%
#60	20-40%
#100	20-30%
#200	<30%
#270	<25%
2 µm	<20%

The Fine Compost shall conform to the requirements of Section 9-14.4(8)

Topsoil Submittal Requirements

At least 10 Working Days prior to placement of any soils, the Contractor shall submit the following test results from an independent accredited soils-testing laboratory, for samples gathered and tested less than 90 days prior. The laboratory analysis shall be with a sample size of no less than 2 pounds.

1. Grain size analysis results for Sandy Loam. Using method ASTM D422

2. STA / Washington State Department of Transportation Technical Data Sheet for Compost, from a STA accredited lab.

3. Test results from an accredited soil laboratory for all soil mixes, including the following parameters:
    a. Total and Soluble Nitrogen (NO3 + NH3)
    b. Phosphorus
    c. Potassium
    d. pH

e. Organic Matter % (Loss on Ignition method)
f. Conductivity
g. Calcium
h. Sulfur
i. Boron

4. Recommendations. Fertilizer and amendment recommendations from an accredited Soil Scientist or Agronomist; for the specified plant type and soil application depth.

5. Mix Samples. Two one (1) gallon samples of each soil mix.

Topsoil Acceptance

Contractor shall not place any soils until the Engineer has reviewed and confirmed the following:

1. Deliver tickets must show that the full delivered amount of soil matches the product type, volume and Manufacturer named in the submittals.

2. Delivered product shall be compared to the submitted sample to verify that it matches the submitted sample

The Engineer may inspect any loads of soil and/or delivery tickets on delivery and stop placement if the delivered soil does not appear to match the submittals; and require sampling and testing of the delivered soil before authorizing soil placement. All testing cost shall be the responsibility of the contractor.

2.07 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural limestone containing a minimum of 80 percent calcium carbonate equivalent and as follows:
   1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36-mm) sieve and a minimum of 75 percent passing through No. 60 (0.25-mm) sieve.
   2. Class: O, with a minimum of 95 percent passing through No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through No. 60 (0.25-mm) sieve.
   3. Provide lime in form of dolomitic limestone.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through No. 40 (0.425-mm) sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.

G. Sand: Clean, washed, natural or manufactured, free of toxic materials.

H. Diatomaceous Earth: Calcined, diatomaceous earth, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.08 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 6.0to 8.5; moisture content 35 to 55 percent by weight;
   1. Medium Compost shall meet the following gradation: 100 percent passing through 1-inch (25-mm) sieve; 90 percent passing through 5/8-inch sieve, 75 percent passing through ¼-inch sieve;

2. Fine Compost shall meet the following gradation: 100 percent passing through a 1-inch sieve; 90 percent passing through a 5/8-inch sieve, 75 percent passing through a 1/4-inch sieve.
3. Soluble salt content of 5 to 10 decisiemens per meter; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
4. Organic Matter Content: 50 to 60 percent of dry weight.
5. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
6. Compst shall have a maximum particle length of 4 inches
7. Medium compost shall have a carbon to nitrogen ratio (C:N) between 18:1 and 35:1. The carbon to nitrogen ratio shall be calculated using the dry weight of "Organic Carbon" using TMECC 04.01A divided by the dry weight of "Total N" using TMECC 04.02D.
8. Maturity shall be greater than 80 percent in accordance with U.S. Composting Council TMECC 05.05-A, "Germination and Root Elongation".
9. Stability shall be 7-mg CO2–C/g OM/day or below in accordance with U.S. Composting Council TMECC 05.08-B "Carbon Dioxide Evolution Rate".
10. The compost product shall originate from organic feedstocks as defined in WAC 173-350 as "Wood waste", "Yard debris", "Post-consumer food waste", "Preconsumer animal-based wastes", and/or "Preconsumer vegetative waste". The Contractor shall provide a list of feedstock sources by percentage in the final compost product.
11. The Engineer may also evaluate compost for maturity using U.S. Composting Council TMECC 05.08-E "Solvita® Maturity Index". Fine compost shall score a number 6 or above on the Solvita® Compost Maturity Test. Medium compost shall score a 5 or above on the Solvita® Compost Maturity Test.

B. Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.

C. Peat: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water-absorbing capacity of 1100 to 2000 percent.

D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
   1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. (2.4 kg/cu. m) of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. (4 kg/cu. m) of loose sawdust or ground bark.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.09 FERTILIZER

A. General: Approved brands conforming to applicable State fertilizer laws. Uniform in composition, dry, free-flowing, delivered to the site in original unopened containers, each bearing the manufacturer's guaranteed analysis. All fertilizers must be EPA approved.

B. No fertilizer is to be used within 200 feet of or in a biofiltration swale or stormwater management facility. Topsoil may be considered for use as an amendment in barren areas within the 200 foot zone if approved by the Engineer.

C. Fertilizer shall not be used unless a need is established for the site as shown by a soil test. The test shall establish the need, formulation, and application rate.

D. Trees, Shrubs and Ground Cover: Formula 4.2.2 "Transplanter" as manufactured by Pacific Agro Co., with Hercules Nitroform and W.R. Grace's "Magamp" and trace elements. Apply at rate of:

Trees:	8 oz.
Shrubs:	4 oz.
Ground Cover:	2 oz.

E. Agriform Tablets: Planting tablets, 21-gram size, as manufactured by Agriform International Chemicals, Inc., 20-10-5 analysis. Apply at the rate of:

Trees:	4 tablets
Shrubs:	1 tablet
Ground Cover:	1 tablet

2.10 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
   1. Type: Medium to fine ground Douglas Fir. Provide in ornamental (i.e. non-enhancement/mitigation) plant beds to a depth of 2″.

B. Arborist Wood Chip Mulch shall be coarse ground wood chips (approximately ½" to 6" along the longest dimension) derived from the mechanical grinding or shredding of the above-ground portions of trees. It may contain wood, wood fiber, bark, branches, and leaves; but may not contain visible amounts of soil. It shall be free of weeds and weed seeds Including but not limited to plants on the Island County Noxious Weed list available at: http://extension.wsu.edu/island/nrs/noxious/weed-list/, and shall be free of invasive plant portions capable of re-sprouting, including but not limited to horsetail, ivy, clematis, knotweed, etc. It may not contain more than 1/2% by weight of manufactured inert material (plastic, concrete, ceramics, metal, etc.).

2.11 TREE STABILIZATION MATERIALS

A. Stakes and Guys:
   1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated, pointed at one end.
   2. Flexible Ties: Straps of length required to reach stakes. “Gro-Straight” tree ties in required lengths and of uniform color.

B. Root-Ball Stabilization Materials:
   1. Proprietary Devices: Proprietary at- or below-grade stabilization system to secure each new planting by root ball; sized as indicated and per manufacturer’s written recommendations.
      a. Products:
         1) Flexible ties and “Gro-Straight” tree ties in required lengths and of uniform color.
         2) Planter anchors: Cast in place concrete deadman, 6" x 18" with three galvanized u-bolts as detailed.

2.12 MISCELLANEOUS PRODUCTS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer’s written instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect’s acceptance of layout before planting. Make minor adjustments as required.

D. Lay out exterior plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

F. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

H. Planting Areas: Apply 'Roundup' in all planting areas in accordance with manufacturer's recommendations and as necessary to remove weed growth.

Scarify upper 1 inch layer of organic matter using Rotara with counter rotating vertical tines. Remove spoils by rolling or scraping with lightweight front-end loader and dispose of on site as directed.

Spade surface with multi-shovel type machine in 2 directions. Restore finish grade with an orchard type level with roller using lightweight tractor.

Following installation of irrigation piping, add specified soil amendments and incorporate into soil to a minimum six inch depth with multiple passes using Rotara with counter-rotating vertical tines and soil packer bar.

Rake, float, drag, roll, and perform all necessary operations to remove surface irregularities and to provide a firm, smooth surface with positive surface drainage.

Remove all rocks, sticks and other debris 1″ and larger in planting areas and seeded areas and dispose of on site as directed. Box drag and hand rake all seeded areas.

Finish grade after preparation of topsoil shall be 1/2″ below adjacent paved surfaces unless otherwise specified or detailed.

3.03 PLANTING AREA PREPARATION

A. Loosen subgrade of planting beds to a minimum depth of 6 inches (150 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

B. Finish Grading: Grade planting beds to a smooth, 3% minimum slope (mounded where surrounding grade is less than 3%), uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

C. Before planting, restore planting beds if eroded or otherwise disturbed after finish grading.

3.04 EXCAVATION FOR TREES AND SHRUBS

A. Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.
   1. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
   2. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
   3. If drain tile is shown or required under planted areas, excavate to top of porous backfill over tile.

B. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
   1. Hardpan Layer: Drill 6-inch- (150-mm-) diameter holes, 24 inches (600 mm) apart, into free-draining strata or to a depth of 10 feet (3 m), whichever is less, and backfill with free-draining material.

C. Drainage: Notify Landscape Architects if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.

D. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.05 TREE AND SHRUB PLANTING

A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1.

B. Set balled and burlapped stock plumb and in center of pit or trench with top of root ball as detailed adjacent finish grades.
   1. Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
   2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

C. Set container-grown stock plumb and in center of pit or trench with top of root as detailed adjacent finish grades.
   1. Carefully remove root ball from container without damaging root ball or plant.
   2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

D. Compost Mulching and River Rock Mulching: Apply 2-inch (50-mm) average thickness of mulch. Do not place mulch within 3 inches (75 mm) of trunks or stems.

3.06 TREE AND SHRUB PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees and shrubs as directed by Landscape Architect.

C. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character.

3.07 TREE STABILIZATION

A. Trunk Stabilization: Unless otherwise indicated, provide trunk stabilization as follows:
   1. Upright Staking and Tying: Stake trees of 2- through 5-inch (50- through 125-mm) caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend dimension shown above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
   2. Use 2 stakes for trees up to 12 feet (3.6 m) high and 2-1/2 inches (63 mm) or less in caliper; 3 stakes for trees less than 14 feet (4.2 m) high and up to 4 inches (100 mm) in caliper. Space stakes equally around trees.
   3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
   4. Support trees with two strands of tie wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

3.08 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants as indicated.

B. Dig holes large enough to allow spreading of roots and backfill with planting soil.

C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

D. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

E. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.09 PLANTING BED MULCHING

A. Mulch backfilled surfaces of planting beds and other areas indicated.
   1. Mulch: Apply 3-inch average thickness of mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

3.10 PLANT MAINTENANCE

A. Tree and Shrub Maintenance: Maintain plantings by pruning, cultivating, watering, weeding, restoring planting saucers, adjusting and repairing root-ball stabilization, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings.

B. Ground Cover and Plant Maintenance: Maintain and establish plantings by watering, weeding, mulching, and other operations as required to establish healthy, viable plantings.

C. Seeded Areas: Minimize unnecessary traffic over seeded areas until established. Maintain by watering, continuous weeding, reseeding, fertilizing, rolling and top dressing, and other necessary operations to establish and maintain an even, dark green, deep rooted, thick and vigorous stand of grass. Hand water or provide a temporary irrigation system for any areas (including rough grass) that are not irrigated, until establishment. Contractor's temporary irrigation method must be capable of watering all areas once per day.

3.11 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

3.12 DISPOSAL

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 32 90 00

This page intentionally left blank

SECTION 33 08 55

COMMISSIONING OF FUEL FACILITY SYSTEMS

PART 1 GENERAL

1.01 SUMMARY/APPLICABILITY

A. This specification defines the requirements and procedures for startup and commissioning of fuel facility systems. It covers requirements for safety, Contracting Agency scheduling and coordination, device testing, system flushing and cleaning, demonstration of indicated and specified system performance and final acceptance and reporting.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 1-06
   1. Preconstruction Submittals
      a. Commissioning Plan
   2. Test Reports
      a. Piping Flushing Checklist
      b. Piping Cleaning Checklist
      c. Control Valve Checklist
      d. Commissioning Report
   3. Certificates
      a. Certification of Completion
      b. Disposal of Waste Materials

1.03 SAFETY

A. Prior to any on-site commissioning activities, the following safety procedures shall be accomplished in all fueling areas to be commissioned under this specification section: testing/operation of emergency eyewash facilities, placement of Contractor-provided portable eyewash units within 100 feet or 10 seconds from the fueling point, verification of proper grounding throughout system, coordination with Contracting Agency Fire and Safety Office and Fuels personnel, placement of Contractor-provided spill pads, placement of Contractor-provided fire extinguishers capable of extinguishing a fuel fire. Ensure that all radios/devices at all Class I, Division 1 areas are intrinsically safe.

1.04 SYSTEM SUPPLIER INVOLVEMENT

A. The System Supplier is defined in Specification Section 33 52 10 SERVICE PIPING FUEL SYSTEMS. The Contractor and the System Supplier shall work together to prepare the work plan, commissioning plan, test reports and final reports. They shall both be present during all commissioning activities and shall coordinate and schedule the work during construction, testing, calibration and acceptance of the system, and operator training. The System Supplier shall be responsible to the Contractor for scheduling all Contractor, sub-Contractor, and manufacturer's service personnel during system startup and final commissioning.

1.05 COMMISSIONING PLAN

A. The Contractor shall submit a detailed written plan with input from the system supplier for implementation of system commissioning. The commissioning plan shall specify a detailed plan incorporating in an sequenced manner all work specified in PART 3 EXECUTION of this specification section. The plan shall be submitted for Contracting Agency approval 90 calendar days prior to commencement of fuel system commissioning. The plan shall include:
   1. Personnel. List of Contractor's personnel by trade, list of key personnel, list of safety equipment, list of miscellaneous equipment such as two-way radios, and personnel transportation vehicles.
   2. Performance Testing. Detailed equipment startup procedures and schedules to perform all system tests under each operating scenario in accordance with paragraph entitled "Performance Tests".
   3. Test forms. Develop all test forms required for documenting the fuel system commissioning work. The format of the test forms shall follow the sequencing and

terminology of the commissioning plan and shall furnish data grids and ample areas for test data recording.

4. Schedule. Schedules shall generated listing dates and durations of all commissioning activities as well as regular coordination and safety meetings and dates of key events for Contracting Agency participation.
5. Fuel. Quantities of fuel needed for all commissioning activities and fuel delivery schedules. Plan shall include requirements and schedules for Contracting Agency-provided materials and equipment.
6. Contingency plans. Information on spill and fire contingencies, along with the required Contracting Agency Fire and Safety Office involvement and approvals.
7. Coordination with Contracting Agency. Description of how Contractor and system supplier shall implement system start-up in coordination with ongoing Contracting Agency operations. Plan shall incorporate all phasing and work restriction requirements of the Contract Documents.

1.06 CERTIFICATION OF COMPLETION

A. As a prerequisite to fuel system commissioning, the Contractor shall submit a Certificate of Completion that certifies all work provided on the fuel system, except for field painting, has been inspected and approved by the specified approving authorities. Further, the Contractor shall certify on this certificate that all specified checks and inspections have been successfully completed prior to commissioning. The Contractor shall give the Contracting Agency Representative at least 45 calendar days notice prior to commencement of fuel system commissioning. The Contractor shall submit the Certificate of Completion to the Contracting Agency Representative at least 7 calendar days prior to commencement of system commissioning. The Contracting Agency Representative shall then be responsible for scheduling Contracting Agency representatives for participation in the inspection, performance testing, and final approval activities. Any contractual deficiencies observed shall be corrected by the Contractor without cost to Contracting Agency.

1.07 COMMISSIONING REPORT

A. Contractor shall prepare a commissioning report that documents the execution of the approved commissioning plan. All items of work specified in the commissioning plan shall be carried out and reported in this report unless otherwise approved by the Contracting Agency Representative. Include as a part of this report verification letters of approved fuel storage tank hydrostatic tests and the piping hydrostatic tests, as generated under other specification sections. The commissioning report shall include the final settings of the control valves and pressure and flow switches and a copy of the strip chart graphs with an explanation of what each graph indicates and what the system is doing.

PART 2 PRODUCTS

2.01 DESIGN CONDITIONS

A. Temporary flushing lines and equipment shall be equal in strength, stability, and materials to the associated permanent components; however, temporary spools may be carbon steel.

2.02 CONTRACTOR PROVIDED MATERIALS AND EQUIPMENT

A. The Contractor shall provide all material, equipment and labor required for proper start-up of the system(s), except for that specified to be Contracting Agency furnished. Equipment shall include but not be limited to the following:
   1. Temporary strainers.
   2. Pipe spools.
   3. Flow meters.
   4. Pressure Gages.
   5. Electronic sensors and strip recorders for pressure and flow recording are included in the PCP. This equipment shall be used to monitor and record the system during the "Equipment Test" and "Performance Testing" portions of this Specification Section.

Recorded data shall be used by the Contractor and equipment factory representatives to achieve final control valve and equipment adjustments. Recorded data shall include:

1) Fueling pumps discharge pressures.
2) Supply Venturi flow rates.
3) Back Pressure Control Valve upstream pressures.
4) Back Pressure Control Valve downstream pressures.
5) Return Venturi flow rates.

6. The Contractor must have on hand sufficient filter/separator elements and cartridges to adequately clean the system. During cleaning operation specified in paragraph below, "Cleaning, Testing and Sampling", Contractor shall provide a flow versus pressure drop graph for each filter. Contractor shall change elements and cartridges per manufacturer's recommended maximum DP at the actual flow rate, or when pressure drop is less than previously graphed or fails to increase properly.
7. Refueled tanker trucks for flushing and draining of the system.
8. The Contractor shall be responsible for providing the electrical power from a source identified by Contracting Agency to the testing locations.
9. Temporary filtration/strainers.

PART 3 EXECUTION

3.01 PRELIMINARY REQUIREMENTS

A. All activities listed in paragraph "PART 3 EXECUTION" shall be performed sequentially in the order they are presented. Prior to any on-site commissioning activities, the Contractor shall ensure that all requirements of the paragraph entitled "Safety" are satisfied. Project shall be substantially complete and Contractor's work area shall be free of debris, trash and obstacles. Perform the following activities prior to receipt of fuel:

B. Electrical Preparations. Prior to energizing the electrical equipment, verify that short-circuit links have been removed from current transformer and that secondary circuits have been connected. Verify all electrical transmitter connections and ensure proper calibration. Verify all electrical equipment meets Class I Division 1 requirements. Verify correct rotation of all motors prior to testing. Verify paddle type flow switches by physically actuating vanes and checking outputs. Conduit explosion-proof sealoffs shall be poured after initial electrical checks but before fuel receipt.

C. Emergency Fuel Shutoff (EFSO) System Testing. Prior to initial fuel receipt, verify that each switch will trip the circuit breaker of the fuel pumps and de-energize the EFSO relay and close the main emergency fuel shut-off valve.

D. Storage Tanks. Verify operation of tank level alarms.

E. Piping System. Ensure that all piping weld integrity and coating inspections have been performed per the applicable specifications. Include verification of approved test results for information in the commissioning report. Evacuate all accumulated water from piping low point drains, valve cavities, and equipment drains. Verify all bolted connections are tightness tested to required torque using a calibrated torque wrench. Verify that all pressure gauges are properly located and installed. Ensure that piping's cathodic protection system is tested and operational. Ensure that pipe marking and identification is provided as specified. Ensure that piping system thermal relief provisions are installed and operating as designed. Verify the correct installation of piping expansion loops, joints, and supports.

1. Float Piping Systems. For floats over-water piping installations, ensure compliance with the Contractor's previously approved spill control plans.

3.02 PREPARATIONS FOR FLUSHING

A. Upon completion of the construction to the satisfaction of the Contracting Agency Representative, the Contractor shall make the following preparations for system flushing.

B. Protection Of Equipment. The following components shall be removed from the system prior to start of flushing operations and, where applicable, replaced with pipe spools of internal diameter equal to the item removed.

1. Control valves.

2. Flow and pressure sensors which are exposed to the system flush.
3. Fuel meters. After flushing, the above items shall be reinstalled in the system and the spool sections turned over to the Contracting Agency Representative.

C. Water Draw-Off. Remove any accumulated water from storage tanks' sumps and bottoms. Drain water and return fuel via filtration to storage tank. Repeat process until all water is removed.

3.03 INITIAL FUEL RECEIPT

A. General. Utilize one storage tank for initial fuel receipt to isolate contaminated fuel. Initial receipt of fuel shall be done by gravity if possible. The Contractor shall station personnel throughout piping system at high point vents to bleed air. All flanges and equipment will be periodically inspected for leaks during filling procedures.

B. Storage Tanks. Receipt flow rate into storage tank shall not exceed 3 feet per second (FPS), as measured in the main receipt piping.

C. Components. Ensure that filter/separators and other vessels are filled slowly by closing outlet valves and venting through air eliminators. Downstream valves shall be throttled to maintain a packed condition in vessels throughout initial fill of piping system. Differential pressure across strainers and filters shall be continuously monitored. Any time a strainer or filter DP reaches 20 psig, it shall be cleaned or replaced.

D. Fuel Quality. Fuel used during initial receipt shall be considered contaminated and shall be positively isolated, with blind flanges or closed, padlocked manual valves, from any truck fueling operations. Fuel isolation shall continue until all flushing and cleaning is completed.

E. Fuel Receipt.
1. Receipt by Commercial Truck. Coordinate with Contracting Agency personnel to schedule quantity of trucks required. Contractor's personnel shall be positioned at the unloading facility, at the utility enclosure, and at the receipt tank, all in radio contact. Contractor shall provide a written summary of truck receipt procedures to the Contracting Agency Representative. If truck unloading system is newly constructed, perform initial receipt, flushing, and testing prior to performance testing.

F. Initial Low Point Flush. Perform an initial low point flush operation by flushing each low point drain through a portable basket strainer for 10 seconds at a system pressure of 30 psig. Repeat flush until basket strainer collects no additional debris.

G. Storage Tank and Piping Hydrostatic Tests with Fuel. After initial receipt of fuel into storage tanks, perform tank hydrostatic tests with fuel per Specification Section 33 52 10 Fuel-Oil System. Remaining system piping shall be packed with fuel, following procedures outlined in paragraph "General" above. Perform piping hydrostatic tests with fuel per the applicable specifications, ensuring the piping system is completely vented of air through the piping high point vent system. Contractor shall submit a tank and piping testing checklist to ensure the requirements of this and other applicable specifications are met.

3.04 FLUSHING

A. The intent of the flushing operation is to remove bulk solids and water from the system. Flushing procedures shall precede cleaning procedures. All new fuel piping, pier and float piping, utility enclosure piping, supply and return lines from the storage tanks, shall be flushed with fuel.

B. Flushing Requirements. Begin flushing of fuel system pipelines at low flow rates using one delivery pump. Slowly increase flushing flow rate with additional pumps until a +/-12 FPS fuel velocity is achieved or to full flow capacity for a minimum of 30 minutes. For gravity, suction, or other non-pumped piping segments, minimum flushing volume shall be four times the pipe volume. Flushing shall continue until the fuel being delivered is free of construction debris to the satisfaction of the Contracting Agency Representative. Samples of fuel shall be taken and tested by the designated Contracting Agency agency and shall be free of gross contamination and visible free water.

C. Fueling System Piping. The flushing of system pipelines shall be accomplished by pumping fuel from one storage tank through the fueling system piping. After high-speed flush of main system piping, all piping laterals shall be flushed with at least one refueling truck (5000 gallons) of fuel. Air shall be bled from system high points. The procedure shall be continued until the fuel being delivered into the tanks is acceptable to the Contracting Agency Representative. After the main piping system has been flushed to the satisfaction of the Contracting Agency Representative, and periodically during the flushing operation, the Contractor shall flush all high point vents and low point drains for a minimum of 10 seconds at a pressure of 30 psig. Remove any accumulated water from storage tank sumps and bottoms. Strainers shall be kept clean in order to insure maximum flow rate. All accumulated material from the strainers shall be reviewed and identified, including source if possible. Upon completion of the first flushing operations, the strainers shall be cleaned, reinstalled, and remain in the system. In addition, baskets from all strainers shall be removed and cleaned.

D. Float Piping. Float piping must be hydrostatically tested with fresh water per the applicable specification. After testing, flush piping with fresh water at 12 FPS for 30 minutes. Drain all water from piping system and refill with product. Perform flushing with product at 12 FPS for 30 minutes. After approval by the Contracting Agency Representative.

E. Piping Flushing Checklist. The Contractor shall generate a comprehensive matrix of all new piping sections in the system. Matrix shall serve as an Contracting Agency's piping inventory and a checklist for all Contractor-provided flushing operations. Column entries shall include pipe section name, location, diameter, approximate length, flushing fuel velocity and volume achieved and acceptable results of sampling.

3.05 CLEANING, TESTING, AND SAMPLING

A. After the completion of the initial flushing and cleaning, all new piping shall be cleaned in accordance with the procedure specified hereafter. The intent of this cleaning operation is to remove trace solids and water from the system.

B. Preparation for Cleaning. Filter elements shall be installed in the filter/separators. Adjust filter/separator flow control valve. Valves and equipment removed for flushing shall be reinstalled. Tanks shall be drained, vapor freed and cleaned per the tank cleaning specification. Transfer the contents from one storage tank to the other through the filter/separators for the purposes of cleaning. Provide temporary filtration as required to prevent cross-contamination of fuel.

C. Cleaning Requirements. Pump fuel through all new piping sections in the system. Fuel velocity during all cleaning operations shall be full pumping capacity. Minimum cleaning volume through non-pumped piping segments shall be four times the pipe volume. Cleaning shall continue until Contracting Agency Representative certifies that the fuel contains 2 milligrams per gallon or less of particulate and 10 parts per million or less of free water. Perform sampling at all system discharge points, at tanks, and throughout piping system. Sampling and testing shall be done by an independent testing laboratory.

D. Cleaning Procedure. During cleaning procedure periodically bleed air through high point vents and flush low point drains for a minimum of 10 seconds at a system pressure of 30 psig. Monitor pressure drop through the filter/separators during each cleaning operation and provide flow vs. pressure drop graphs. Any time filter/separator DP reaches its maximum allowable value, vessel elements should be replaced.

E. Piping Cleaning Checklist. The Contractor shall generate a comprehensive matrix of all new piping sections in the system. Matrix shall serve as a checklist for all Contractor-provided cleaning operations. Column entries shall include pipe section name, location, diameter, approximate length, fuel velocity and volume achieved, and acceptable results of sampling.

3.06 CONTROL VALVE ADJUSTMENT

A. All control valve settings shall be checked and field adjusted from the factory settings at start-up as necessary to provide a smooth operation.

B. Control Valve Checklist. The Contractor shall generate a comprehensive matrix of all control valves in the system. Matrix shall serve as a checklist of all required control valve features, settings, and functions as specified. Submit matrix with commissioning "Final Reports".

3.07 EQUIPMENT TESTS

A. After completion of flushing, cleaning, and control valve and electrical component adjustments, the equipment tests and performance tests specified hereinafter shall be performed. After cleaning is complete and prior to performance testing, field adjust automatic control valves and automatic pump controls. For final adjustment of installed electrical control equipment the Contractor shall provide an experienced electrical engineer, factory representative of control panel manufacturer. Both the mechanical and electrical components shall be adjusted concurrently. Tests will be witnessed by Contracting Agency representatives.

B. Emergency Fuel Shutoff System (EFSO). With one fueling pump operating, test each "Emergency Stop" pushbutton station to verify that the pumps stop and fuel control valve of each dispenser close. Demonstrate operation of the EFSO station at the control center. Repeat this procedure for each fueling pump. Conduct tests for both the automatic and manual modes. With all the fueling pumps circulating fuel through the system, push an "Emergency Stop" pushbutton station, ensure all pumps stop, and emergency fuel control valves close at each dispenser.

3.08 PERFORMANCE TESTS

A. During performance testing, the Contractor shall demonstrate that all portions of the fuel system are operating as designed and specified. Tests shall be performed under all operating scenarios. Additional tests may be required by the Contracting Agency Representative to fully demonstrate system performance. These tests shall be accomplished by the Contractor at no additional cost to Contracting Agency. The Contractor shall notify the Contracting Agency Representative 15 calendar days in advance of the test to permit arrangement for the use of Contracting Agency furnished items. Record required data necessary to prepare reports specified in paragraph entitled "Commissioning Report".

B. Fuel Receipt Systems (for Gasoline and for DFM).
   1. Drop tank systems. Demonstrate the following features:
      a. Tank overfill valve closure upon tank high level condition.
      b. Level alarm actuation.
      c. On/off staging of pumps by tank level alarms/probes.
      d. Pump shutdown on tank low level condition.
      e. Tank leak detection system performance (remove probes and actuate by dipping into water/fuel test buckets).
      f. Manual start/stop pushbutton control.
      g. Tank gauging system.
      h. Pump shutdown upon no-flow condition signal from flow switch.
      i. Receipt meter performance.

C. Demonstrate all other tank features and functions per the applicable specifications.

D. Marine Fueling Systems. Demonstrate the following features:
   a. Performance of dispenser meters and verification of proper calibration.
   b. Performance of filter/separators.
   c. Dispensing hose/nozzle assembly function and operating range.
   d. Operation of vents, drains, air eliminators, and hose connections.

E. Satisfactory Performance. In the event a portion of the system or any piece of equipment fails to meet the test, the Contractor shall make the necessary repairs or adjustments and repeat the Performance Test until satisfactory performance is obtained. Measured flow rates should be within 5 percent of design. Tank level gauging and alarm measurements should be within 5 of design. Any component found not to be working as specified shall be repaired/replaced by the Contractor at no additional cost to Contracting Agency. The determination of satisfactory performance shall be made by the Contracting Agency representatives. The system shall be filled with fuel and shall be operable and leak-free prior to acceptance. The Contractor shall be

responsible for any leaks in the new or modified portions of the system. Anything wet with fuel is considered to be leaking.

3.09 TRAINING / INSTRUCTION FOR GOVERNMENT PERSONNEL

A. The contracting authority should provide one or two key personnel from their "operations" and "maintenance" departments to participate in all phases of system commissioning. The Contractor and System Supplier will be responsible for coordinating the involvement and training of these individuals during the startup process, including hands-on familiarization and adjustment of devices, valves, and components.

B. In addition, the Contractor and System Supplier shall conduct an 8-hour formal training session at the conclusion of system performance testing. This session shall include initial classroom system presentations as well as a complete system walk-through. The function, operation and maintenance procedures for all system devices and components will be explained. Training shall be videotaped and submitted in CD ROM or DVD format.

3.10 PROJECT CLOSEOUT

A. Ensure that As-Built drawings, equipment warranty documentation, and other project closeout activities are completed per the requirements of the applicable specifications.

END OF SECTION 33 08 55

This page intentionally left blank

SECTION 33 14 16
SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.01 DESCRIPTION

A. This work-in consists of construction water main in accordance with the Stand Plans, at the location shown in the plans.

1.02 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.

PART 2 PRODUCTS

2.01 WATER PIPE

A. In accordance with Section 7-09.2 of the Standard Specifications

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. In accordance with Section 7-09.3 of the Standard Specifications.

END OF SECTION 33 14 16

This page intentionally left blank

SECTION 33 16 00
STORAGE TANKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Underground water tanks for containment and storage of water from floor drains inside the HHW and ROF buildings.

1.02 RELATED REQUIREMENTS

A. Section 31 20 00 “Earthwork.”

B. Section 03 30 00 “Concrete.”

1.03 REFERENCES

A. Underground Water Tanks in the United States:
   1. American Concrete Institute (ACI) standard ACI 318, Building Code Requirements for Structural Concrete.
   2. ANSI/AWWA D120 - Thermosetting Fiberglass-Reinforced Plastic Tanks.
   3. Tank manufacturer shall be recognized by Underwriters Laboratories as a manufacturer of tanks listed to the UL-1316 standard.

1.04 SUBMITTALS

A. Submit under provisions of Section 01300 - Administrative Requirements.

B. Product Data: Submit manufacturer's data sheets on each product to be used, including, but not limited to, the following:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation manual and operating guidelines.

C. Shop Drawings: Tank manufacturer shall submit the following for review and approval prior to fabrication of the tanks:
   1. Detailed shop drawings of each tank complete with all accessories supplied by the manufacturer.
   2. Detailed shipping, handling and installation instructions.

1.05 QUALITY ASSURANCE

A. Tank installations in the United States:
   1. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with tank manufacturer's Installation and Operating Guidelines recommendations for delivery, storage, and tank handling.

1.07 WARRANTY

A. Warranty: Provide manufacturer's standard limited warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Tank installations in the United States:
   1. Acceptable Manufacturer: Xerxes Corporation.

B. Substitutions:
   1. Requests for substitutions will be considered in accordance with provisions of Section 1-06.7 - Product Requirements.

2.02 UNDERGROUND WATER TANKS

A. Tank Design - Fiberglass reinforced plastic (FRP) tanks:
   1. The tank size, fittings and accessories shall be as shown on the drawings.

2. Tank shall be manufactured with structural ribs which are fabricated as in integral part of the tank wall.
3. Tank shall be manufactured with a laminate consisting of resin and glass fiber reinforcement only. No sand/silica fillers or resin extenders shall be used.
4. Tank shall be vented to atmospheric pressure.
5. Tank shall be capable of handling liquids with specific gravity up to 1.1
6. Tank shall be compatible with liquids identified in the manufacturer's standard limited warranty.

B. Loading Conditions - Tank shall meet the following design criteria:
1. Internal Load - Tank shall be designed to withstand a 5-psig (35 kPa) air-pressure test with a 5:1 safety factor.
2. Surface Loads - Tank shall be designed to withstand surface H-20 and HS-20 axle loads when properly installed according to manufacturer's current Installation Manual and Operating Guidelines.
3. External Hydrostatic Pressure - Tank shall be designed for 7 feet (2.1 m) of overburden over the top of the tank, the hole fully flooded, and a safety factor of 5:1 against general buckling.

C. Stormwater Detention Applications:
1. Governing Standards, as applicable:
a. ANSI/AWWA D120 - Thermosetting Fiberglass-Reinforced Plastic Tanks.
b. American Concrete Institute (ACI) standard ACI 318, Building Code Requirements for Structural Concrete.
c. Tank manufacturer shall be recognized by Underwriters Laboratories (UL) as a manufacturer of tanks listed to the UL-1316 standard.
2. Tank Accessories:
a. Tank Anchoring:
1) Anchor straps shall be as supplied by tank manufacturer and designed for a maximum load of 25,000 lbs (11340 kg).
2) Galvanized turnbuckles shall be supplied by the tank manufacturer.
3) Prefabricated concrete anchors shall be supplied by the tank manufacturer, designed to the ACI 318 standard, manufactured with 4,000 psi concrete and shall have adjustable anchor points.
b. Access Openings:
1) All access openings shall have a diameter of 24 inches or 30 inches (610 mm or 762 mm), complete with riser, lid and necessary hardware.
c. Attached Access Risers:
1) Attached access risers shall be PVC or FRP as supplied by tank manufacturer.
2) Attached access risers shall be 24 inches or 30 inches (610 mm or 762 mm) diameter
3) Access risers shall be attached to access openings during installation utilizing adhesive or FRP bonding kits as supplied by the tank manufacturer.
d. Piping and Fittings:
1) Tank shall be equipped with factory-installed threaded fittings, or pipe stubs.
2) PVC piping shall at a minimum meet the requirements of ANSI Schedule 40.
3) All flanged nozzles shall be flanged and flat-faced, and conform to Class 150 bolting patterns as specified in ANSI/ASME/ B16.5.
4) Carbon steel and stainless steel NPT fittings shall withstand a minimum of 150 foot-pounds (203 NM) of torque and 1,000 foot-pounds (1356 NM) of bending, both with a 2:1 safety factor.

e. Manway Openings:
1) The standard manway shall be flanged, 22 inches (559 mm) I.D. and complete with gaskets, bolts and cover.
2) Manway openings shall be designed to withstand 5-psig (35 kPa) test pressure with a 5:1 safety factor.

f. Ladders: Ladders shall be the standard FRP ladder as supplied by tank manufacturer.
g. Pumps and accessories: Provide pump and pump accessories for 20 amp pump with 2-inch piping connection for pumping water from the tank.

PART 3 EXECUTION

3.01 TESTING

A. Tank shall be tested according to the tank manufacturer's Installation Manual and Operating Guidelines in effect at time of installation.

3.02 INSTALLATION

A. Tank shall be installed according to the tank manufacturer's Installation Manual and Operating Guidelines in effect at time of installation.

END OF SECTION 33 16 00

This page intentionally left blank

SECTION 33 31 23.01
OSS EFFLUENT TRANSPORT PIPING

PART 1 GENERAL

1.01 DESCRIPTION

A. The construction of OSS effluent transport pipe sewerage force main as shown in the plans, Appendix C, and Kitsap Public Health District regulations.

PART 2 PRODUCTS

2.01 FORCE MAIN PIPE MATERIALS

A. Polyfusion HDPE 2” diameter effluent transport pipe

B. PVC Schedule 40 2” diameter effluent transport pipe in accordance with WSDOT specification 9-30.1(5)B

C. PVC Schedule 3034 sleeving pipe in accordance with WSDOT specification 9-30.1(5)A

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with the plans, details of Appendix C, and Kitsap Public Health District Regulations.

B. Install a minimum of 3’ below finish grade.

END OF SECTION 33 31 23.01

This page intentionally left blank

SECTION 33 34 13
SEPTIC TANKS AND PUMP CHAMBERS

PART 1 GENERAL

1.01 SUBMITTALS

A. Septic installer certification with Kitsap Public Health.

B. Shop Drawings: Catalog cut of tanks and chambers.

C. Provide project Record of Construction information to the designer.

PART 2 PRODUCTS

2.01 SEPTIC TANK

A. Tank Capacity: 1,000 gallon.

B. Hagerman tanks or equivalent.

2.02 PUMP CHAMBER

A. Tank Capacity: 1,000 gallon.

B. Hagerman tanks or equivalent.

2.03 SUBMERSIBLE CENTRIFUGAL PUMP SYSTEM

A. Furnish pumps, connecting pipes, check valves, float switches, service valved, risers, threaded unions, and control panel and panel conduit and conductors as shown in the plans and Appendix C.

B. Liberty 280 pump or equivalent.

2.04 CONNECTING PIPE MATERIALS

A. 4’ diameter PVC Plastic Pipe Schedule 3034.

2.05 BACKFILL MATERIALS

A. Tank and Chamber Backfill Material: Gravel borrow per Standard Specification 9-03.14(1).

2.06 CONTROL PANEL SYSTEM

A. Furnish control panel, conduit, and conductors as shown in the plans, OSS details of Appendix C

B. SJE Rombus Simplex or equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with Kitsap Public Health District standards.

END OF SECTION 33 34 13

This page intentionally left blank

SECTION 33 34 51
OSS DRAINFIELDS

PART 1 GENERAL

1.01 SUBMITTALS

A. Septic installer certification with Kitsap Public Health.

B. Catalog cuts of all system components shown on plans, and OSS details of Appendix C.

PART 2 PRODUCTS

2.01 DRAINFIELD

A. Piping as specified on OSS details of Appendix C.

2.02 CONTROL VALVES

A. As specified in OSS details of Appendix C.

2.03 PEA GRAVEL

A. Shall meet the following gradation:
   1. 80-100% passing the 3/8” sieve
   2. 10-30% passing the #4 sieve
   3. 0-10% passing the #8 sieve
   4. 0-1% passing the #200 sieve

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with Kitsap Public Health District regulations.

END OF SECTION 33 34 51

This page intentionally left blank

SECTION 33 42 11
STORMWATER GRAVITY PIPING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This Section includes the installation of drain pipe, underdrain pipe, culvert pipe, storm sewer lines, inlets, and catch basins as described in the plans.

PART 2 PRODUCTS

2.01 MATERIALS

A. In accordance with Standard Specification Sections 7-01.2, 7-02.2, 7-04.2, 7-05.2, and 9-30.1(1)

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. In accordance with Standard Specification Sections 7-01.3, 7-02.3, 7-04.3, 7-05.3, and 7-08.3

END OF SECTION 33 42 11

This page intentionally left blank

SECTION 33 46 00
STORMWATER MANAGEMENT

PART 1 GENERAL

1.01 SUBMITTALS

The Contractor shall submit Type 2E Working Drawings and supporting calculations to the Engineer in accordance with Section 1-05.3 and Section 6-02.3(25)A for the Stormwater Detention Vault. The Contractor shall not begin installation prior to receiving approved Working Drawings from the Engineer.

The following items shall be submitted unless specified otherwise herein.

A. Preconstruction Submittals
   1. The precast manufacturer shall submit a copy of their quality control/assurance manual, which establishes quality control procedures.

B. Drawings
   1. Section 6-02.3(28)A, items 1 through 6
   2. Drawings shall show the design loads and standards have been met.
   3. Details for all precast components included base, top, side, and end walls, sediment baffle wall, including reinforcement details for pipe knockouts.
   4. Complete, site specific, itemized bar list for all steel reinforcement. Details of steel reinforcing size and placement shall be submitted with a professional engineering stamp and calculations.
   5. The drawing for submittal shall show locations and dimensions to all penetrations and special embed items. Product dimensions and thicknesses shall be shown, and the drawing shall be to a common architectural scale with the precast producer's information in the title block.
   6. The vault drawings shall include a concrete placement plan identifying joint types, joint locations, and concrete placement sequence.
   7. Erection and backfill procedure.

C. Precast Concrete Unit Data
   1. Anchorage, Lifting Inserts and Devices
      a. For anchors, lifting inserts and other devices, the precast concrete producer shall provide product data sheets and proper installation instructions upon request.
   2. Accessory Items
      a. For items including, but not limited to sealants, gaskets, pipe entry connectors, steps, racks, and other items installed before or after delivery, the precast concrete producer shall include proper installation instructions and relevant product data upon request.

D. Design Data
   1. The precast concrete producer shall supply submittals showing design loading and material specifications for supplied products. At a minimum, the following shall be shown on the submittals:
      - Live load used in design
      - Vertical and lateral earth loads used in design
      - Depth of soil fill on the structure
      - Water table depth used in calculations
   2. Upon request, the precast concrete producer shall supply precast concrete unit design calculations and concrete mix design proportions and appropriate mix design test data. Structural design calculations shall be sealed by a licensed professional engineer in the state of this project.

E. Test Reports
   1. Upon request, the precast concrete producer shall supply copies of material certifications and/or laboratory test reports, including mill tests and all other test data, for Portland cement, blended cement, pozzolans, ground granulated blast-furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

2. Upon request, the precast concrete producer shall submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the project conditions. Such tests may include compressive strength, plastic air content, temperature of freshly mixed concrete, and slump of freshly mixed concrete. Special tests for precast concrete items shall be clearly detailed in the specifications
3. Upon request, the precast concrete producer shall supply copies of in-plant QA/QC inspection reports.

1.02 PRECAST CONCRETE VAULT DESIGN

The precast unit design shall meet the following design criteria:

A. Precast Concrete Unit Design

Design standard precast concrete units to withstand design load conditions in accordance with the applicable industry design standards. Design must also consider stresses induced during handling, shipping, and installation in order to avoid product cracking or other handling damage. Design loads for precast concrete units shall be indicated on the shop drawings, and designed by a licensed professional engineer.

Vault Design

Loads:

The vault shall be designed for a live load of HS-25 (AASHTO Load Factor

Design method, LFD) and a fire truck outrigger load of 43,000 pounds, applied to an area of 24 inches by 24 inches located on 16-foot centers, where it will produce the maximum moment in the vault lid.

Standards: ASTM C857 "Minimum Structural Design Loading for Underground Precast Concrete Utility Structures", ACI-318-05 Building Code, and ASTM C88 "Underground Precast Concrete Utility Structures".

Vault shall be designed for saturated soil loading. with a minimum cover of 2 feet and a max cover of 5 feet.

The Contractor shall provide the vault design and method of shoring the vaults for the Engineer's approval. The vault design shall satisfy the design criteria and professional engineer's certification, as specified herein.

Geotechnical design parameters (e.g. lateral earth pressures; bearing, passive lateral and sliding resistances; skin friction for buoyancy; etc.) are discussed in the Geotechnical Engineering, see Section 1-02.4(2).

The groundwater table shall be assumed to be above the top elevation of the vault.

PART 2 PRODUCTS

2.01 MATERIALS

Reinforcement

Reinforcing Bars: ASTM A 615, Grade 60, deformed.

Steel-welded Wire Fabric: ASTM A 185, plain, cold drawn.

Supports for Reinforcement: Provide supports for reinforcement, including bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcing, complying with CRSI recommendations.

Ladders, Covers and Risers

Vault access ladders shall be made of polypropylene coated steel materials and meets requirements of AASHTO M199.

A. Joints and Sealants
   1. Joints and sealants between adjacent units shall be of the type and configuration indicated on the shop drawings meeting specified design and performance requirements.

B. Concrete Mix Design
   1. Concrete type

a. For non machine cast products, the concrete shall be self-consolidating concrete which produces minimal bugholes and does not segregate.

2. Concrete Proportions
   a. Selection of proportions for concrete shall be based on current self- consolidating concrete mix design techniques. At a minimum, ACI 211.1 shall be used.
   b. Upon request the precast concrete producer shall submit a mix design for each strength and type of concrete that will be used. Submitted mix designs shall include the quantity, type, brand and applicable data sheets for all design constituents as well as documentation indicating conformance with applicable reference specifications.
3. Durability and Performance Requirements
   a. Concrete Compressive Strength
      1) Precast concrete units shall have a 28-day compressive strength of 6000 psi for SCC.
   b. Water-Cementitious Ratio
      1) Concrete that will be exposed to freezing and thawing shall contain air and shall have a water-cementitious ratio of 0.45 or less. Concrete which will not be exposed to freezing, but which is required to be leak resistant, shall have a water-cementitious ratio of 0.48 or less. For corrosion protection, reinforced concrete exposed to deicer salts, brackish water or seawater shall have a water-cementitious ratio of 0.40 or less.
   c. Air Content
      1) The air content of concrete that will be exposed to freezing conditions shall be within the limits given below

Nominal Maximum Aggregate size (in)	Air Content %	
	Severe Exposure	Moderate Exposure
3/8	6.0 to 9.0	4.5 to 7.5
1/2	5.5 to 8.5	4.0 to 7.0
3/4	4.5 to 7.5	3.5 to 6.5
1	4.5 to 7.5	3.0 to 6.0
1-1/2	4.5 to 7.0	3.0 to 6.0
*For specified compressive strengths greater than 5000 psi, air content may be reduced 1%		

C. Impermeable Layer: Group A-4 in accordance with ASTM D3282.

2.02 OUTLET STRUCTURES FOR STORMWATER PONDS

A. Precast Concrete: Reinforced, integrated lift rings, in accordance with ASTM C913.

B. Corrugated Metal: Galvanized sheet steel in accordance with ASTM A929/A929M with helical lock seams.

C. Trash Racks: Cast iron, heavy duty bar screen.

D. Concrete Base: See Section 03 30 00.

PART 3 EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. Handling

Precast concrete units shall be handled and transported in a manner to minimize damage. Lifting devices or holes shall be consistent with industry standards. Lifting shall be accomplished with methods or devices intended for this purpose as indicated on the shop drawings. Upon request, the precast concrete producer shall provide documentation on acceptable handling methods for the product.

B. Storage

Precast concrete units shall be stored in a manner that will minimize potential damage.

C. Delivery

Precast concrete units shall be delivered to the site in accordance with the delivery schedule. Upon delivery to the jobsite, all precast concrete units shall be inspected by the customer's agent for quality and final acceptance.

The delivery of the precast concrete units shall be scheduled to meet the traffic control requirements of Section 1-07.23(1). Delivery of precast concrete units, staging and placement, shall be coordinated with traffic control plans.

D. Final Acceptance

Upon final acceptance, the customer's agent acknowledges and understands the appropriate methods for handling the accepted precast concrete unit(s). Upon acceptance by the customer or customer's agent, the precast concrete manufacturer is not responsible for replacing damaged product resulting from improper handling practices on the job site.

3.02 MANUFACTURERS

Approved Fabricators

The following manufacturer are approved for fabrication of precast reinforced concrete vault structures when designed, fabricated, and constructed in accordance with these Specifications:

Oldcastle Precast
P.O. Box 588
Auburn, WA 98002

Granite Precasting and Concrete, Inc.
4116 Bakerview Spur
Bellingham, WA 98226

H2 Pre-Cast Inc.
3835 N Clemons
East Wenatchee, WA 98802

Or an approved substitute manufacturer. An approved substitute manufacturer shall be defined as a manufacturer meeting the requirements of these specifications, and the following Quality Assurance and Manufacturing criteria:

A. Quality Assurance

The precast concrete producer shall demonstrate adherence to the standards set forth in the plant Quality Control Manual. The precast concrete producer shall meet the requirements written below. The precast concrete producer shall provide a limited warranty for their product of at least 2 years in length.

B. Qualifications, Quality Control and Inspection
   1. The precast producer shall maintain a permanent quality control department.
   2. The precast concrete producer shall have a quality control program which is audited for compliance annually by persons outside that plant's employee structure.
   3. Upon request, the precast concrete producer shall supply a copy of their quality control manual.

C. Quality Control
   1. The precast concrete producer shall show that the following quality control tests are performed as required and in accordance with the ASTM International standards indicated.
      a. Concrete Testing
         1) Slump: A slump test shall be performed at least once per day per mix design used. Slump tests shall be performed in accordance with ASTM C 1611 for self-consolidating concrete.

2) Temperature: The temperature of fresh concrete shall be measured each time a slump, air content, or compressive strength tests are made. Temperature shall be measured in accordance with ASTM C 1064.
3) Compressive Strength: At least four compressive strength specimens shall be made each day for each mix design unless otherwise specified. In accordance with ASTM C 31, C 39, C 192.
4) Air Content: Tests for air content shall be performed if the mix design specifies air entrainment. The air content will be measured in accordance with ASTM C 231. The Air Content shall be measured once per day per mix design.
5) Density (Unit Weight): Tests for Density (Unit Weight) shall be performed monthly for each mix design used at a minimum. Tests shall be in accordance with ASTM C 138

b. Aggregate Testing
1) A full set of aggregate tests shall be performed on each aggregate at least annually by an independent testing agency or an in house test lab. These tests will include gradations (ASTM C136), Soundness (ASTM C 88), Organic Impurities (ASTM C 40), Sand Equivalent for fine aggregates only (ASTM D 2419)
2) Potential reactivity shall be performed once per each aggregate source, and when aggregate sources change (ASTM C 1260 or C 1293)
3) Monthly, at a minimum, gradations shall be performed per ASTM C 33.
4) Aggregate Moisture tests: Moisture tests on aggregates shall be performed in accordance with ASTM C 70 or ASTM C 566. Fine aggregate moisture content tests shall be performed at least once per day if there are no moisture meters, otherwise it shall be performed once per month. Alternatively the speedy moisture test is acceptable (ASTM D 4944).

c. Preplacement Check
1) All products shall be inspected for accuracy after the concrete forms have been removed. Checks shall include, but not be limited to, dimensional checks, finishing, insert locations, squareness, honeycombing, cracking, marking, coatings, racking, hole size and location. Postplacement checks may require a corrective action report.
2) Preplacement checks shall be documented and initialed by the inspector. A drawing with verifications of the above criteria can be used as documentation.

d. Postplacement Check
1) All products shall be inspected for accuracy after the concrete forms have been removed. Checks shall include, but not be limited to, dimensional checks, finishing, insert locations, squareness, honeycombing, cracking, marking, coatings, racking, hole size and location. Postplacement checks may require a corrective action report.
2) Postplacement checks shall be documented and initialed by the inspector. A drawing with verifications of the above criteria can be used as documentation.

2. Copies of the test results and Inspections above shall be available upon request.

D. Outside Inspection

The customer or customer’s agent (specifier) may place an inspector in the plant when the units covered by this specification are being manufactured. The precast concrete producer shall give notice of 3 days prior to the time the precast concrete units will be available for plant inspection

3.03 MANUFACTURING

Manufacturing shall conform to the producer’s acceptable quality control manual

A. Forms
1. Forms for manufacturing precast concrete units shall be of the type and design consistent with industry standards and practices. They should be capable of consistently providing uniform products and dimensions. Forms shall be constructed so that the forces and vibrations to which the forms will be subjected cause no damage to the precast concrete unit.

2. Forms shall be cleaned of concrete build-up after each use.
3. Form release agents shall be applied according to the manufacturer's recommendations and shall not be allowed to build up on the form casting surface.

B. Reinforcement
1. Cages of reinforcement shall be fabricated by tying the bars, wires or welded wire reinforcement. The tolerances for concrete cover shall be 3/8 in. or as specified in the design. Welding shall be allowed only for ASTM A 706 rebar.
2. Positive means shall be taken to assure that the reinforcement does not move significantly during the casting operations.

C. Embedded Items

Embedded items shall be positioned at locations specified in the design documents. Inserts and other embeds shall be held rigidly in place so that they do not move significantly during casting operations.

D. Concrete
1. Concrete Mixing
a. Mixing operations shall produce batch-to-batch uniformity of strength, consistency and appearance
2. Concrete placing
a. Concrete shall be placed in a manner in which it flows and consolidates without segregation or air entrapment. The freefall of concrete shall be kept to a minimum.
b. Cold Weather Concreting
1) Recommendations for cold weather concreting are given in detail in ACI 306 R. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near- freezing temperatures. All concrete materials, reinforcement, and forms shall be free from frost. In cold weather, the temperature of the concrete at the time of placement shall not be below 45 degrees F. Concrete that freezes before it reaches a compressive strength of 500 psi shall be discarded.
c. Hot Weather Concreting
1) Recommendations for hot weather concreting are given in detail in ACI 305 R. During hot weather excessive concrete temperatures and water evaporation shall be minimized. The temperature of concrete at the time of placing shall not exceed 95 degrees F.
3. Concrete Curing
a. Curing operations shall commence immediately following the initial set of the concrete and completion of surface finishing.
b. Curing by moisture retention
1) Precast products shall be protected from drafts and wind to prevent plastic shrinkage cracking.
2) Moisture shall be prevented from excessively evaporating from exposed surfaces until adequate strength for stripping the precast concrete unit from the form is reached.
c. Curing with Heat and Moisture
1) Concrete shall not be subjected to steam or hot air until after the concrete has attained its initial set. If hot air is used, precautions shall be taken to prevent moisture loss from the concrete. The temperature of the concrete shall not be permitted to exceed 150 degrees F. The temperature gain shall not exceed 40 degrees F per hour.
4. Surface Finish
a. The surface finish shall be as specified on the contract documents and/or approved shop drawings.
5. Stripping Precast Concrete Units from Forms

Precast concrete units shall not be removed from the forms until the concrete reaches the compressive strength for stripping required by design. Stripping strengths shall be routinely measured to ensure product has attained sufficient strength for safe handling.

6. Patching and Repair
   a. Repairing Minor Defects

      Defects that will not impair the functional use or expected life of the precast concrete unit may be repaired by any method that does not impair the product
   b. Repairing Honeycombed Areas

      When honeycombed areas are to be repaired, all loose material shall be removed and the areas cut back into essentially horizontal or vertical planes to a depth at which coarse aggregate particles break under chipping rather than being dislodged. Proprietary repair materials shall be used in accordance with the manufacturer's instructions. Otherwise, the area shall be saturated with water. Immediately prior to repair, the area should be damp, but free of excess water. A cement-sand grout or an approved bonding agent shall be applied to the chipped surfaces, followed immediately by consolidating an appropriate repair material into the cavity.
   c. Repairing Major Defects

      Defects in precast concrete products which impair the functional use or the expected life of products shall be evaluated by qualified personnel to determine if repairs are feasible and, if so, to establish the repair procedure.
7. Shipping Precast Concrete Units

   Precast concrete units shall not be shipped until they have reached at least 70% of their specified 28-day design strength, unless damage will not result, impairing the performance of the product.

The Contractor shall submit a dewatering and water quality plan for the Engineer's approval at least 10 calendar days prior to dewatering. Included in these plans shall be intended placement of Best Management Practices (BMP's) to be used for sediment and erosion control. The approved erosion control system shall be in place prior to beginning dewatering.

The Contractor shall remove, treat, and discharge excess water from the work area as necessary to complete the work described. Standards for quality of water leaving the work site shall meet the requirements the Clean Water Act, and the Construction General Stormwater Permit. The Contractor shall monitor and adjust dewatering operations as necessary during construction to ensure the above standards of water quality are met at all times.

Examination

Prior to installation of the precast concrete vault, the Contractor shall examine the vault for compliance with dimensional and size requirements, including installation tolerances, true and level bearing surfaces, and other conditions affecting performance of precast concrete units. Any dimensional sizes and finishes not in accordance with the requirements shall be corrected by the Contactor, prior to installation.

Finish formed surfaces of precast concrete shall be a smooth finish. Small surface holes caused by air bubbles, normal color variations, and form joint marks, and minor chips and spalls will be tolerated. Major or unsightly imperfections, honeycombs, irregular surfaces, or structural defects are not permitted.

The Contractor shall provide a representative from the precast vault manufacturer to be on-site full-time during vault base preparation and installation of the vault to ensure proper installation of their product.

Identify pickup points of precast concrete units and orientation in structure with permanent markings, complying with markings indicated on final shop drawings. Imprint casting date on each precast unit on a surface that will not show in the finished structure.

Excavation for Vault and installation

Excavation, shoring, and backfill shall meet the requirements of Section 2-09.

Install precast units level, plumb, square, and true. Shore and brace precast concrete units to maintain location, stability, and alignment until permanent connections are installed. The correct placement of the storm vault is important in order to form a smooth surface.

Backfilling should be done after vault is completely assembled making certain to compact the backfill progressively from the bottom to the top surface.

Joint sealant, pipe-entry connectors and other penetrations shall be sealed according to manufacturer's requirements to ensure the integrity of the system to resist leaking.

All risers, covers, conduit of specific sections of vaults is the responsibility of the Contractor and shall be performed in accordance with Section 7-05.3.

Erection

The Contractor shall erect and backfill the precast reinforced concrete structures in accordance with the erection sequence specified in the shop drawings approved by the Engineer.

Casting

The Contractor shall notify the Engineer at least five working days in advance of beginning fabrication of the structures for this project.

The Contractor shall mark the following information, using waterproof paint, on the inside of a vertical leg of each section of the structure:

Design Loads

Span and Rise dimension

Job Number

Fabrication Date

Manufacturer's Name and Trademark

Install warning signs as approved by OSHA, warning of entrance to confined space area. Install at each access riser.

Base Preparation

The subgrade shall be compacted in accordance with Method C per Section 2-03.3(14)C and must be approved by the Engineer prior to installation of crushed surfacing vault base material.

Vault Cleaning

Vault shall be cleaned and left free of debris at the approval of the Engineer prior to activation of the vault.

3.04 POND CONSTRUCTION

A. Fill to contours and elevations indicated using unfrozen materials.

B. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen, or spongy subgrade surfaces.

C. Maintain optimum moisture content of fill materials to attain required compaction density.

3.05 POND OUTLET CONSTRUCTION

A. Form concrete base pad according to drawings, trowel top surface level.

B. Precast Structure: Place structure sections plumb and level, trim to correct elevations.

C. Corrugated Structure: Install elbow fitting and sections plumb and level, trim to correct elevations.

END OF SECTION 33 46 00

SECTION 33 46 02
STORMWATER HYDRODYNAMIC SEPARATOR

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The installation of stormwater hydrodynamic separator as shown on the plans.

1.02 SUBMITTALS

A. Detail Drawing provided by manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS

A. In accordance with 6-20.2 unless otherwise indicated by the manufacturer.

B. Contech Engineered Solutions LLC, CDS3020-6-C Inline CDS.

C. Or approved equal

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Install in accordance with and with manufacturer's instructions.

B. In accordance with Standard Specification 6-20.3.

END OF SECTION 33 46 02

This page intentionally left blank

SECTION 33 46 03
STORMWATER OIL SEPARATOR

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The installation of stormwater oil separator as shown on the plans.

1.02 SUBMITTALS

A. Shop drawing provided by manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS

A. In accordance with 6-20.2 unless otherwise indicated by the manufacturer.

B. Contech Engineered Solutions LLC, Vortclarex VCL 30.

C. Or approved equal.

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Install in accordance with and with manufacturer's instructions.

B. In accordance with Standard Specification 6-20.3.

END OF SECTION 33 46 03

This page intentionally left blank

SECTION 33 46 04
STORMWATER BIOFILTRATION VAULT

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The installation of stormwater biofiltration vault as shown on the plans.

1.02 SUBMITTALS

A. Shop Drawings.

PART 2 PRODUCTS

2.01 MATERIALS

A. In accordance with 6-20.2 unless otherwise indicated by the manufacturer

B. BioClean MWS-L-4-6.33’-10”-V-UG Stormwater Biofiltration System.

C. Or approved equal.

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Install in accordance with and with manufacturer’s instructions.

B. In accordance with Standard Specification 6-20.3.

END OF SECTION 33 46 04

This page intentionally left blank

SECTION 33 52 10

FUEL-OIL SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fuel-oil and diesel-fuel-oil distribution systems and the following:
   1. Pipes, tubes, and fittings.
   2. Piping and tubing joining materials.
   3. Piping specialties.
   4. Valves.
   5. Horizontal, steel, fuel-oil ASTs.
   6. Insulated, steel, fuel-oil ASTs.
   7. Fuel-oil AST accessories.
   8. Fuel-oil storage tank piping specialties.
   9. Fuel-oil storage tank pumps.
   10. Liquid-level gauge system.
   11. Leak-detection and monitoring system.
   12. Concrete bases (for day tanks and pump sets).

1.02 RELATED REQUIREMENTS

A. Section 23 00 00 “General Mechanical Requirements”

B. Section 31 20 00 “Earthwork”

1.03 REFERENCES

A. General: Requirements of following codes and standards, as referenced herein are made a part of this Specification as if they were fully stated.

B. API: American Petroleum Institute.
   1. API Specification 12P: Fiberglass Reinforced Plastic Tanks.
   2. API Standard 650: Welded Steel Tanks for Oil Storage.
   3. API RP 1615: Installation of Underground Petroleum Storage Systems.
   4. API Standard 2000: Venting Atmospheric and Low-Pressure Storage Tanks.

C. ASME: American Society of Mechanical Engineers.
   1. ASME B16.3: Malleable Iron Threaded Fittings.
   2. ASME B31.4: Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids.
   3. ASME B31.9: Building Services Piping.
   4. ASME B36.10M: Welded and Seamless Wrought Steel Pipe.

D. ASTM: American Society for Testing and Materials.
   1. ASTM A53/A53M: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   2. ASTM A234/A234M: Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
   3. ASTM D2310: Standard Classification for Machine-Made “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
   4. ASTM D2996: Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

E. AWS: American Welding Society.
   1. AWS A5.8: Specification for Filler Metals for Brazing and Braze Welding.

F. 2012 IFC: International Fire Code.
   1. Chapter 57: Flammable and Combustible Liquids.

G. IMC: International Mechanical Code.
   1. Chapter 13: Fuel Oil Piping and Storage.

H. MSS: Manufacturers Standardization Society of Valve and Fittings Industry, Inc.

1. MSS SP-80: Bronze Gate, Globe, Angle, and Check Valves.
2. MSS SP-110: Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved Ends.

I. NFPA: National Fire Protection Association.
1. NFPA 30: Flammable and Combustible Liquids.
2. NFPA 31: Standard for Installation of Oil Burning Equipment.

J. PEI: Petroleum Equipment Institute.
1. RP200 – Recommended Practices for the Installation of Aboveground Storage Tanks.

K. UL: Underwriters Laboratories.
1. UL 142: Steel Aboveground Tanks for Flammable and Combustible Liquids.
2. UL 2085: Protected Aboveground Tanks for Flammable and Combustible Liquids

1.04 DEFINITIONS

A. AST: Aboveground storage tank.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

E. FPM: Vinylidene fluoride-hexafluoropropylene copolymer rubber.

F. FRP: Glass-fiber-reinforced plastic.

G. UST: Underground storage tank.

H. Carrier Piping: Piping that contains fuel oil exclusively.

I. Secondary Containment Piping System: System that contains carrier piping and prevents fuel leakage from carrier piping into surrounding soil and/or water. System may be either boxed-in trench or double-walled piping.

J. Acronyms Used:
1. AST Aboveground Storage Tank
2. DDC Direct Digital Controls
3. FOCP Fuel Oil Control Panel
4. FOP Fuel Oil Pump
5. FOR Fuel Oil Return
6. FOS Fuel Oil Supply
7. FOT Fuel Oil Tank
8. FOCV Fuel Oil Control Valve
9. FOV Fuel Oil Vent
10. FPM Vinylidene fluoride-hexafluoropropylene copolymer rubber
11. HOA or H/O/A Hand / Off / Automatic
12. PLC Programmable Logic Controler
13. PLLD Pressurized Line Leak Detection
14. WAC Washington Administrative Code
15. UST Underground Storage Tank

1.05 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design restraint and anchors for fuel-oil piping, ASTs, and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: Factory-installed support attachments for AST shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1.06 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles. Also include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   1. Piping specialties.
   2. Valves: Include pressure rating, capacity, settings, and electrical connection data of selected models.
   3. Each type and size of fuel-oil storage tank. Indicate dimensions, weights, loads, components, and location and size of each field connection.
   4. Fuel-oil storage tank accessories.
   5. Fuel-oil storage tank piping specialties.
   6. Fuel-oil storage tank pumps.
   7. Fuel maintenance system.
   8. Liquid-level gauge system.
   9. Leak-detection and monitoring system.

B. Shop Drawings: For facility fuel-oil piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
   1. Shop Drawing Scale: 0.25 inch per foot.
   2. For fuel-oil storage tanks and pumps, include details of supports and anchors.

C. Delegated-Design Submittal: For fuel-oil piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of anchors and seismic restraints.
   2. Design Calculations: Calculate requirements for selecting seismic restraints.
   3. Detail fabrication and assembly of pipe anchors, hangers, supports for multiple pipes, and attachments of the same to building structure.

1.07 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which fuel-oil piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Site Survey: Plans, drawn to scale, on which fuel-oil piping and tanks are shown and coordinated with other services and utilities.

C. Qualification Data: For qualified professional engineer.

D. Seismic Qualification Certificates: For ASTs, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Brazing Certificates: Provide.

F. Welding Certificates: Provide.

G. Field Quality-Control Reports: Provide.

H. Warranty: Provide sample of special warranty.

1.08 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuel-oil equipment and accessories to include in emergency, operation, and maintenance manuals.

1.09 MATERIALS MAINTENANCE SUBMITTALS

A. Extra Materials: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuel Filters : Provide one spare filter for all fuel filter locations.

1.10 QUALITY ASSURANCE

A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. Steel Support Welding Qualifications: Provide.

C. Procedures and Personnel: Qualify procedures and personnel according to AWS D1.1/D1.1M, “Structural Welding Code - Steel.”

D. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. ASME: Comply with ASME B31.9, “Building Services Piping,” for fuel oil piping materials, installation, testing, and inspecting.

G. EPA: Comply with requirements of the EPA and of state and local authorities having jurisdiction. Include recording of fuel oil storage tanks and monitoring of tanks and piping.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Transportation: Lift and support fuel-oil storage tanks only at designated lifting or supporting points, as shown on Shop Drawings. Do not move or lift tanks unless empty.

B. Piping Protection: Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Pipe Coatings: Store pipes and tubes with protective PE coating to avoid damaging the coating and to protect from direct sunlight.

D. Sunlight: Store PE pipes and valves protected from direct sunlight.

1.12 COORDINATION

A. Concrete Bases: Coordinate sizes and locations of concrete bases with actual equipment provided.

1.13 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of fuel-oil storage tanks and flexible, double-containment piping and related equipment that fail in materials or workmanship within specified warranty period.
   1. Storage Tanks:
      a. Failures include, but are not limited to, the following when used for storage of fuel oil at temperatures not exceeding 150 degrees F
         1) Structural failures including cracking, breakup, and collapse.
         2) Corrosion failure, including external and internal corrosion of steel tanks caused by reaction of tank with soil environment.
      b. Warranty Period: 10 years from date of Substantial Completion.
   2. Flexible, Double-Containment Piping and Related Equipment:
      a. Failures due to defective materials or workmanship for materials installed together, including piping, dispenser sumps, entry boots, and sump mounting adapters.
      b. Warranty Period: 30 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

A. Fuel Pipe: Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.

2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M, for butt and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   a. Material Group: 1.1.
   b. End Connections: Threaded or butt welding to match pipe.
   c. Lapped Face: Not permitted underground.
   d. Gasket Materials: Asbestos free, ASME B16.20 metallic, or ASME B16.21 nonmetallic, gaskets compatible with fuel oil.
   e. Bolts and Nuts: ASME B18.2.1, cadmium-plated steel.
5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
   a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

B. Vent Piping:
1. Belowground: ASTM A53/A53M standard weight, zinc-coated steel with zinc-coated malleable iron fittings ASME B16.3.
2. Aboveground: Schedule 40 fiberglass reinforced pipe and fittings suitable for fuel oil systems.

2.02 DOUBLE-CONTAINMENT PIPE AND FITTINGS

A. Flexible, Double-Containment Piping: Comply with UL 971.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Franklin Fueling APT pipe
   b. Perma-Pipe.
2. RTRP: ASTM D 2996 or ASTM D 2997 carrier and containment piping and mechanical couplings to seal carrier and containment piping or individually bonded joints.
   a. Minimum Operating-Pressure Rating for RTRP NPS 2 and NPS 3: 150 psig.
   b. Minimum Operating-Pressure Rating for RTRP NPS 4 and NPS 6: 125 psig. Compliance with UL 971 is not required for NPS 6 and larger piping.
   c. Fittings: RTRF complying with ASTM D 2996 or ASTM D 2997, and made by RTRP manufacturer; watertight sump entry boots, termination, or other end fittings.
3. Include design and fabrication of double-containment pipe and fitting assemblies with provision for field installation of cable leak-detection system in annular space between carrier and containment piping.

2.03 PIPING SPECIALTIES

A. Flexible Connectors: Comply with UL 567.
1. Metallic Connectors:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Flexicraft.
      2) Circuit Hydraulics.
      3) Penflex.
      4) Metraflex.
   b. Listed and labeled for aboveground and underground applications by an NRTL acceptable to authorities having jurisdiction.
   c. Stainless steel bellows with woven, flexible, bronze or stainless steel, wire-reinforcing protective jacket.
   d. Minimum Operating Pressure: 50 psig.
   e. End Connections: Socket, flanged, or threaded end to match connected piping.
   f. Maximum Length: 30.00 inches.
   g. Swivel end, 50-psig maximum operating pressure.
   h. Factory-furnished anode.

2. Nonmetallic Connectors:
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) Flexicraft.
        2) Circuit Hydraulics.
        3) Penflex.
        4) Metraflex.
    b. Listed and labeled for underground applications by an NRTL acceptable to authorities having jurisdiction.
    c. PFTE bellows with woven, flexible, bronze or stainless steel, wire-reinforcing protective jacket.
    d. Minimum Operating Pressure: 150 psig.
    e. End Connections: Socket, flanged, or threaded end to match connected piping.
    f. Maximum Length: 30.00 inches.
    g. Swivel end, 50-psig maximum operating pressure.
    h. Factory-furnished anode.

B. Manual Air Vents:
1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 degrees F.

C. Dielectric Unions: Union comprised of steel female pipe thread end and copper solder-joint end conforming to dimensional, strength, and pressure requirements of ASME B16.39, Class 1. Steel parts shall be galvanized or plated. Union shall have a water-impervious insulation barrier capable of limiting galvanic current to 1 percent of short-circuit current in a corresponding bimetallic joint. When dry, it shall be able to withstand a 600 V breakdown test.

D. Differential Pressure Gauges: Dwyer series 4000 Capsuhelic differential pressure gauge, plus or minus 3 percent accuracy of full scale, gauge shall be diaphragm actuated dial type, 5-inch outside diameter with white dial, black figures and graduations, and pointer zero adjustment, brass housing, high and low pressure taps, operating range shall register midpoint on dial, submit dial ranges for review.

E. Line Leak Detection Flow Switch: Provide spring-loaded poppet flow switch with bronze body and bonnet, threaded connections, 400-psig rated at 100 degrees F, Teflon shuttle, 316 stainless steel spring, UL listed, single-pull double-throw contacts make or break at 5 gpm flow, 0.5 psi pressure drop at 25 gpm, 2-inch size. Basis of design is Gems series FS 200 model 27103.

F. Vacuum Breakers: Brass body, 300 psig rated, spring-loaded ball check vacuum breaker, 3/4-inch MPT inlet and 1/2-inch FPT outlet, stainless steel ball, EPN O-ring seat. Ball unseats to relieve vacuum at less than 2 inches mercury vacuum. Preferred Utilities VB model 11826.

G. Flow Indicator: Provide steel body construction, 150 psig rated flanged flow indicator with sealed glass window and propeller behind the glass. The visual verification of the propeller rotating shall be verification of flow. The glass shall be held in place with a steel bolted flange retainer. The glass shall be tempered Borosilicate, the propeller shall be of Ryton, the seals shall be Viton, the entire assembly shall be ASME rated at 285 psig at 100 degrees F. OPW model 152 1RF-0202 (two inch size).

H. Fuel Oil Pressure Transducer (Fuel Control Panel Interface): Provide with range to match application. Total output error shall be less than plus or minus 0.5 percent of operating range from minus 20 to 180 degrees F. Ashcroft model K1 for pressure applications. Ashcroft model IXLdp for differential pressure applications.

2.04 JOINING MATERIALS

A. Joint Compound and Teflon-Impregnated Tape: Suitable for fuel oil.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1,000 degrees F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

D. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

2.05 MANUAL FUEL-OIL SHUTOFF VALVES

A. Valve Schedule: See valve schedule in Part 3 for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller for Liquid Service: Comply with UL 842.
   1. CWP Rating: 125 psig
   2. Threaded Ends: Comply with ASME B1.20.1.
   3. Dry-seal Threads on Flare Ends: Comply with ASME B1.20.3.
   4. Tamperproof Feature: Locking feature for valves indicated in the valve schedule.
   5. Service Mark: Initials “WOG” shall be permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with UL 842.
   1. CWP Rating: 125 psig
   2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
   3. Tamperproof Feature: Locking feature for valves indicated in the valve schedule.
   4. Service Mark: Initials “WOG” shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BrassCraft.
      b. Conbraco.
      c. McDonald, A. Y.
   2. Body: Bronze, complying with ASTM B 584.
   3. Ball: Chrome-plated bronze.
   4. Stem: Bronze; blowout proof.
   5. Seats: Reinforced TFE; blowout proof.
   6. Packing: Threaded-body pack-nut design with adjustable-stem packing.
   7. Ends: Threaded, or socket as indicated in the valve schedule.
   8. CWP Rating: 600 psig.
   9. Service Mark: Initials “WOG” shall be permanently marked on valve body.

2.06 SPECIALTY VALVES

A. Pressure Relief Valves: Comply with UL 842.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anderson Greenwood.
      b. Fulflo Specialties.
      c. Webster Fuel Pumps & Valves.
   2. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
   3. Body: Brass, bronze, or cast steel.
   4. Springs: Stainless steel, interchangeable.
   5. Seat and Seal: Nitrile rubber.
   6. Orifice: Stainless steel, interchangeable.
   7. Factory-Applied Finish: Baked enamel.
   8. Maximum Inlet Pressure: 150 psig

9. Relief Pressure Setting: 60 psig

B. Emergency Shutoff Valves: Comply with UL 842.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Morrison.
      b. Conley.
      c. EMCO Wheaton.
      d. Environ.
      e. OPW.
   2. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
   3. Double poppet valve.
   4. Body: ASTM A 126, cast iron.
   5. Disk: FPM.
   6. Poppet Spring: Stainless steel.
   7. Stem: Plated brass.
   8. O-Ring: FPM.
   9. Packing Nut: PTFE-coated brass.
   10. Fusible link to close valve at 165 degrees F.
   11. Thermal relief to vent line pressure buildup due to fire.
   12. Air test port.
   13. Maximum Operating Pressure: 50 psig.

C. Mechanical Leak Detector: Comply with UL 842.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. FE Petro.
      b. Red Jacket Pumps.
      c. Vaporless Manufacturing.
   2. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
   3. Body: ASTM A 126, cast iron.
   4. O-Rings: Elastomeric compatible with fuel oil.
   5. Piston and Stem Seals: PTFE.
   6. Stem and Spring: Stainless steel.
   7. Piston Cylinder: Burnished brass.
   8. Indicated Leak Rate: Maximum 3 gph at 10 psig.
   9. Leak Indication: Reduced flow.

D. Anti-Spill Valves: Where product piping extends below top of primary tank, piping shall include shutoff valve and a normally closed safety valve; safety valve shall be an approved anti-siphon valve with thermal relief.

E. Backpressure Control Valves:
   1. Main Boiler Supply Header: Pilot operated backpressure control valve, Fisher model 63EG with 6358EB stainless steel pilot regulator, 1-inch flanged connections, steel body, 416 stainless steel disk and seat, nitrile elastomer, rated for 150 psig. Capable of flowing 35 gpm of fuel oil with 75 psig inlet and 0 psig outlet pressures.
   2. Day Tank Supply Header: Spring-loaded diaphragm-operated backpressure control valve, Preferred Utilities model V, 1-inch FPT inlet and outlet connections, cast iron body, rated for 250 psig maximum inlet pressure, spring rated for 5-20 psig backpressure range, Viton valve seat, stainless steel valve plug, Teflon composition diaphragm, adjustment screw on top, FPT vent opening in spring case. Each valve capable of flowing 14 gpm of fuel oil with 10 psig inlet and 1.5 psig outlet pressures.

F. Solenoid Valves:

1. Day Tank Fill Valves: Bronze body, threaded end connections, normally closed (apply power to open), 120 volt 60 Hz AC, malleable iron coil enclosure with female, threaded conduit connection, stainless steel valve stem and spring, valve orifice seal metal to metal, Viton valve stem seal. 3/4-inch FPT with 1/2-inch orifice, maximum shutoff pressure is 30 psig, valve CV shall be no less than 3.5, capable of flowing 10 gpm at 8.2 psi pressure drop, Magnatrol model 33NV13.
2. Mechanical Line Leak Detection Solenoid Valves: Bronze body, threaded end connections, normally closed (apply power to open), 120 volt 60 Hz AC, malleable iron coil enclosure with female, threaded conduit connection, stainless steel valve stem and spring, valve orifice seal metal to metal, Viton valve stem seal, 2-inch FPT with 2-inch orifice, maximum shutoff pressure is 100 psig, valve CV shall be no less than 48, capable of flowing 25 gpm at 0.3 psi pressure drop. Magnatrol model 36AV47.
3. Day Tank to Generator Fuel Oil Supply: Bronze body, threaded end connections, normally open (apply power to close), 24 volt DC, 18 watts, malleable iron coil enclosure with female, threaded conduit connection, stainless steel valve stem and spring, valve orifice seal metal to metal, Viton valve stem seal, 1-inch FPT with 1-inch orifice, maximum shutoff pressure is 50 psig, valve CV shall be no less than 13, capable of flowing 4.5 gpm at 0.12 psi pressure drop. Magnatrol model 18ARV24.

2.07 HORIZONTAL, STEEL, FUEL-OIL AST (FT-1 AND FT-2)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ace Tank.
   2. Modern Welding.
   3. Xerxes.
   4. Containment Solutions.

B. Description: UL 142 and NFPA 30 standards double-wall, horizontal steel tank; with primary- and secondary-containment walls and interstitial space.

C. Construction: Fabricated with welded, carbon steel; suitable for operation at atmospheric pressure and for storing fuel oil with specific gravity up to 1.1 and with maintained temperature up to 150 degrees F. Minimum 15 psig tank design working pressure.

D. Supports: Manufacturer’s standard structural steel welded to tank.
   1. Number of Supports: As recommended by manufacturer.

E. Capacities and Characteristics: See Equipment Schedule on Drawings.

2.08 SHOP PAINTING OF AST

A. Prime Coat: Apply manufacturer’s standard prime coat to exterior steel surface of AST and supports.

B. Exterior Surface Preparation: Prepare exterior steel surface of AST and tank supports.

C. Shop Cleaning: After fabrication, blast clean according to SSPC-SP 6/NACE No. 3

D. Surface Cleaning: After cleaning, remove dust or residue from cleaned surfaces.

E. Rust: If surface develops rust before prime coat is applied, repeat surface preparation.

F. Prime Coat: Apply manufacturer’s standard prime coat to shop-cleaned, dry surface same day as surface preparation.

G. Epoxy Finish: Apply manufacturer’s standard two-component, epoxy finish coats.

2.09 FUEL-OIL AST ACCESSORIES

A. Tank Manholes: 22.00-inch-minimum diameter; bolted, flanged, and gasketed; centered on top of tank.

B. Tank Manholes: 22.00-inch-minimum diameter; bolted, flanged, and gasketed; on top and at side of tank.

C. Tank Openings: Threaded pipe connection fittings on top or sides of tank as indicated, for fill, supply, return, vent, sounding, and gauges. Include cast-iron plugs for shipping.

D. Striker Plates: Inside tank, on bottom below fill, vent, sounding, gauge, and other tube openings.

E. Lifting Lugs: For handling and installation.

F. Ladders: Carbon-steel ladder inside tank, anchored to top and bottom, and located as indicated. Include reinforcement of tank at bottom of ladder.

G. Ladders: Carbon-steel ladder outside tank, anchored to top and side wall. Comply with requirements in Section 05 50 00 “Metal Fabrications” for exterior steel ladder.

H. Supply Tube: Extension of supply piping fitting into tank, terminating 6.00 inches above tank bottom and cut at a 45-degree angle.

I. Sounding and Gauge Tubes: Extension of fitting into tank, terminating 6.00 inches above tank bottom and cut at a 45-degree angle.

J. Tank shall have appropriate warning signs as required by NFPA 704 and local regulations.

2.10 FUEL-OIL STORAGE TANK PIPING SPECIALTIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Morrison Bros.
   2. OPW.
   3. Preferred Utilities.
   4. Universal Valve Company.

B. Fitting Materials: Cast iron, malleable iron, brass, or corrosion-resistant metal; suitable for fuel-oil service.
   1. Surface, Flush-Mounted Fittings: Waterproof and suitable for truck traffic.
   2. Aboveground-Mounted Fittings: Weatherproof.

C. Locking Fill Boxes: Flush mounting, with locking-type inner fill cap for standard padlock and threaded fill-pipe connection.

D. Supply and Sounding Drop Tubes: Fuel-oil supply piping or fitting, inside tank, terminating 6.00 inches above bottom of tank, and with end cut at a 45-degree angle.

E. Pipe Adapters and Extensions: Compatible with piping and fittings.

F. Suction Strainers and Check Valves: Bronze or corrosion-resistant metal components.

G. Foot Valves and Anti-Siphon Valves: Poppet-type, bronze or corrosion-resistant metal components.

H. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

I. Metal Manholes: 22.00-inch- minimum diameter frame and cover. Furnish manhole units of adequate size for access to fittings if size is not indicated.

J. Monitoring Well Caps: Locking pipe plug and manhole.

2.11 EMERGENCY FUEL SHUT-OFF (EFSO) STATION

A. Station housing shall be a galvanized steel enclosure with a hinged glass front and an open bottom. Paint the enclosure red. Mounting hardware shall be corrosion resistant. Mount an emergency pushbutton inside the station housing. Pushbutton shall be accessible through the hinged front. Pushbutton shall be a single unit with a jumbo mushroom operator, 1-NC and 1-NO contact. During activation, the pushbutton shall de-energize fuel pumps and maintain contact until deactivated by a key release. Mount a caution sign beside the emergency shutdown station, with red 2 inch letters stating "EMERGENCY SHUTDOWN". The sign shall have white background and be of noncorrosive construction.

2.12 FUELING EQUIPMENT - DIESEL FUEL

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Remote dispensers:
   a. Gilbarco, Inc. (Gasboy).
   b. Tokheim (Dover Fueling Solutions).
   c. Wayne Fueling Systems LLC.

B. Dispensing Unit (DFD-1). Unit and unit hardware shall be the factory fabricated type that conforms to UL 87 or UL 87A, except as modified herein. Unit housing and housing top shall be constructed of stainless steel or powder-coated galvannealed in accordance with UL 87 or UL 87A. Materials for unit components that will be in direct contact with the fuel shall be stainless steel or nickel plated aluminum. Unit shall be lighted, single sided, with one hose outlet suitable for single product delivery flow rate of up to 60 gallons per minute. Unit housing shall include a locking mechanism of the panel access.

C. Dispenser must include 2.0-inch solenoid valve, explosion proof switch, dual element filter assembly with pressure gauge, and deck-mounted stainless steel hose reel with electric power rewind hose return including push button operation from front of dispenser, all rated for 50 psi maximum working pressure.
   1. Accounting Meter and Display
      a. Provide unit with positive displacement rotary type meter and the manufacturer's standard control functions.
      b. Fuel meter unit must be mechanical registration type with 5-digit resettable register, eight-digit accumulative volume totalizer (in gallons).
   2. Interlocks
      a. Provide each unit with interlock switch and valve arrangement that prevents flow of product until meter is reset and dispenser on/off switch is activated.
   3. Nozzle, Hose, and Couplers
      a. Diesel Fuel Rated Flexible Rubber Hose. Provide diesel fuel rated, static dissipating synthetic rubber hose for fuel transfer, with spiral-plied synthetic fabric with helix wire reinforcement, -30 to 180 degrees F, 150 psi working pressure, 1.5 inch inside diameter, 2.03 inch nominal outside diameter, and a 4 inch bending radius. Provide hose reel with spring rewind and 50 feet of hose capacity.
      b. Nozzle. Provide 1.5-inch NPT inlet fuel dispensing nozzle for heavy duty, high-flow delivery service, automatic-shutoff type, rated for 50 PSI maximum pressure with service temperature range of minus 20 degrees F to 140 degrees F, aluminum body, stainless steel main stem, including "green" color coding for Diesel fuel, right angle design, and replaceable spout with dust plug.
   4. Safety Breakaway Device. Provide UL listed emergency breakaway device designed to retain liquid on both sides of breakaway point where indicated. Breakaway device shall have pressure balancing chamber to override line pressure to prevent nuisance breaks caused by a restriction in delivery hose diameter.
   5. Emergency Shutoff Valve. Provide valve that conforms to UL 842. Valve shall provide complete shutoff of a fuel line in the event a dispenser is dislocated or overturned due to a sudden impact. Valve shall include a secondary poppet to limit spillage from the dispenser after a knockdown or during installation.
   6. Dispenser Sump. Provide a sump under each dispensing unit. Each sump shall provide convenient service access to piping components enclosed in the sump. Sump shall be constructed of stainless steel. Dispenser shall be chemically compatible with the fuel to be handled by the dispensing unit and any connecting piping. Sump shall prevent fuel from escaping and prevent rain water from entering the sump. Sump shall provide a liquidtight termination point for secondary containment piping that allows for the anticipated expansion and contraction of the piping system. Sump shall mount directly to the bottom of the dispensing unit with a centering ring or stabilizer bar to assure proper shearing action for the emergency shutoff valve.
   7. Accessories. Equip each assembly with accessories such as built-in air eliminators, line check valves, fuel filters, solenoid valve, and lockable housing.
   8. Provide normally closed solenoid valve, bronze body, 0 to 100 psig maximum pressure differential, continuous duty Class H standard coil, 30 watts at 120 volt AC, with integral

relief allowing valve to relieve expansion pressure in opposite direction of flow, enclosure rated for hazardous location (NEMA 4X), CSA approval for hazardous locations as indicated on the drawings.

2.13 FUELING EQUIPMENT - GASOLINE FUEL DISPENSERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   2. Remote dispensers:
      a. Gilbarco, Inc. (Gasboy).
      b. Tokheim (Dover Fueling Solutions).
      c. Wayne Fueling Systems LLC.

B. Dispensing Unit (GFD-1). Unit and unit hardware shall be the factory fabricated type that conforms to UL 87 or UL 87A, except as modified herein. Unit housing and housing top shall be constructed of stainless steel or powder-coated galvannealed in accordance with UL 87 or UL 87A. Materials for unit components that will be in direct contact with the fuel shall be stainless steel or nickel plated aluminum. Unit shall be lighted, single sided, with one hose outlet suitable for single product delivery flow rate of up to 20 gallons per minute. Unit housing shall include a locking mechanism of the panel access.

C. Dispenser must include 2.0-inch solenoid valve, explosion proof switch, dual element filter assembly with pressure gauge, and deck-mounted stainless steel hose reel with electric power rewind hose return including push button operation from front of dispenser, all rated for 50 psi maximum working pressure.
   1. Accounting Meter and Display
      a. Provide unit with positive displacement rotary type meter and the manufacturer's standard control functions.
      b. Fuel meter unit must be mechanical registration type with 5-digit resettable register, eight-digit accumulative volume totalizer (in gallons).
   2. Interlocks
      a. Provide each unit with interlock switch and valve arrangement that prevents flow of product until meter is reset and dispenser on/off switch is activated.
   3. Nozzle, Hose, and Couplers
      a. Gasoline Fuel Rated Flexible Rubber Hose
         1) Provide gasoline fuel rated, static dissipating synthetic rubber hose for fuel transfer, with spiral-plied synthetic fabric with helix wire reinforcement, -30 to 180 degrees F, 150 psi working pressure, 1.5 inch inside diameter, 2.03 inch nominal outside diameter, and a 4 inch bending radius. Provide hose reel with spring rewind and 50 feet of hose capacity.
      b. Nozzle
         1) Provide fuel dispensing nozzle for heavy duty, high-flow delivery service, automatic-shutoff type, rated for 50 PSI maximum pressure with service temperature range of minus 20 degrees F to 140 degrees F, aluminum body, stainless steel main stem. Nozzle must be provided with vacuum assist vapor recovery components.
   4. Safety Breakaway Device. Provide UL listed emergency breakaway device designed to retain liquid on both sides of breakaway point where indicated. Breakaway device shall have pressure balancing chamber to override line pressure to prevent nuisance breaks caused by a restriction in delivery hose diameter.
   5. Emergency Shutoff Valve. Provide valve that conforms to UL 842. Valve shall provide complete shutoff of a fuel line in the event a dispenser is dislocated or overturned due to a sudden impact. Valve shall include a secondary poppet to limit spillage from the dispenser after a knockdown or during installation.
   6. Dispenser Sump. Provide a sump under each dispensing unit. Each sump shall provide convenient service access to piping components enclosed in the sump. Sump shall be constructed of stainless steel. Dispenser shall be chemically compatible with the fuel to be handled by the dispensing unit and any connecting piping. Sump shall prevent fuel from

escaping and prevent rain water from entering the sump. Sump shall provide a liquid tight termination point for secondary containment piping that allows for the anticipated expansion and contraction of the piping system. Sump shall mount directly to the bottom of the dispensing unit with a centering ring or stabilizer bar to assure proper shearing action for the emergency shutoff valve.

7. Accessories. Equip each assembly with accessories such as built-in air eliminators, line check valves, fuel filters, solenoid valve, and lockable housing.
8. Provide normally closed solenoid valve, bronze body, 0 to 100 psig maximum pressure differential, continuous duty Class H standard coil, 30 watts at 120 volt AC, with integral relief allowing valve to relieve expansion pressure in opposite direction of flow, enclosure rated for hazardous location (NEMA 4X), CSA approval for hazardous locations as indicated on the drawings.

2.14 DISPENSER FUEL CONTROL SYSTEM

A. Provide a complete Dispenser Fueling Control System that is fully operational and coordinated with the existing Control System in the moorage office. The fueling control system must include controls, audible and visual alarms, and interoperability with all fueling system components including the tank management system with tank inventory level, fuel pumps, associated leak detection systems, fuel dispensers, emergency fuel shutoff (EFSO) pushbuttons, and electronic communications to the moorage office fuel systems control panels, as indicated on the drawings and as specified in this and other sections of the specifications.

2.15 FUEL

A. Diesel Fuel Oil: ASTM D 975, Grade Low Sulfur, high volatility.

2.16 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6.00 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30.00 inches deep; colored yellow.

2.17 CONCRETE MANHOLES

A. Precast Concrete Manhole Sections: ASTM C 478, base and concentric-cone sections with integral ladder or steps.

B. Cast-Iron Frame and Cover: Heavy-duty, water-resistant, cast-iron manhole frame, gasket, and bolted cover; 24.00-inch-diameter, inside opening dimension; 8.00-inch frame riser height.

2.18 SOURCE QUALITY CONTROL

A. Pressure Test and Inspection: Pressure test and inspect fuel-oil storage tanks, after fabrication and before shipment, according to ASME and the following:
   1. Horizontal, Double-Wall Steel ASTs: UL 142, STI F921, and STI R931.
   2. FRP USTs: UL 1316.

B. Tank Markings: Affix standards organization’s code stamp.

PART 3 EXECUTION

3.01 EXAMINATION

A. Initial Investigation: Examine roughing-in for fuel-oil piping system to verify actual locations of piping connections before equipment installation.

B. Corrections: Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 EARTHWORK

A. Excavation, Trenching, and Backfilling: Comply with requirements in Section 31 20 00 “Earthwork”for excavating, trenching, and backfilling.

3.03 PREPARATION

A. Equipment Isolation: Close equipment shutoff valves before turning off fuel oil to premises or piping section.

B. Safety: Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

3.04 PIPE ROUTING

A. General: Protect piping material from entry of foreign materials with temporary end caps. Maintain in place until installation. During installation, protect piping systems from entry of foreign materials by use of temporary covers, completing sections of work, and isolating parts of completed system.

B. Vent Pipe: Support vent pipe at building wall and terminate minimum 12.00 feet above grade and 5.00 feet from building opening, or as detailed on Drawings. Terminate with UL approved weatherproof, spark arrestor, and vent cap.

C. Pipe Assembly: Place unions and flanges where necessary to permit easy disconnection of piping and apparatus. Each connection having a threaded end valve shall have a union.

3.05 OUTDOOR PIPING INSTALLATION

A. Underground Piping: Install underground fuel-oil piping buried at least 18.00 inches below finished grade. Comply with requirements in Section 31 20 00 “Earth Moving” for excavating, trenching, and backfilling.

B. Steel Piping with Protective Coating:
   1. Apply joint cover kits to pipe after joining, to cover, seal, and protect joints.
   2. Replace pipe having damaged PE coating with new pipe.

C. Scope: Install double-containment, fuel-oil pipe at a minimum slope of 1 percent downward toward fuel-oil storage tank sump.

D. Vet Piping: Install vent pipe at a minimum slope of 2 percent downward toward fuel-oil storage tank sump.

E. Entry Boots: Assemble and install entry boots for pipe penetrations through sump sidewalls for liquid-tight joints.

F. Tank Connections: Install metal pipes and tubes, fittings, valves, and flexible connectors at piping connections to AST and UST.

G. Changes in Direction: Install fittings for changes in direction in rigid pipe.

H. System Components: Install system components with pressure rating equal to or greater than system operating pressure.

I. Pressure Gauges: Install pressure gauge on suction and discharge from each pump. Pressure gauges are specified in Section 23 05 19 “Meters and Gauges for HVAC Piping.”

3.06 VALVE INSTALLATION

A. Shutoff Valves: Install manual fuel oil shutoff valves on branch connections to fuel oil appliance.

B. Valve Locations: Install valves in accessible locations. Install valves with stems upright or horizontal, not inverted. Valve installations shall allow for operation and repair.

C. Protection: Protect valves from physical damage.

D. Metal Tags: Install metal tag attached with metal chain indicating fuel oil piping systems.

E. Identification: Identify valves as specified in Section 23 05 53 “Identification for HVAC Piping and Equipment.”

F. Safety Valves: Install oil safety valves at inlet of each oil-fired appliance.

G. Pressure Relief Valves: Install pressure relief valves in distribution piping between the supply and return lines.

H. Low Points: Install one-piece, bronze ball valve with hose end connection at low points in fuel-oil piping.

I. Air Vents: Install manual air vents at high points in fuel-oil piping.

J. Emergency Shutoff Valves: Install emergency shutoff valves at dispensers.

3.07 PIPING JOINT CONSTRUCTION

A. Burrs: Ream ends of pipes and tubes and remove burrs.

B. Pipe Preparation: Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to “Quality Assurance” Specification.
   1. Bevel plain ends of steel pipe.
   2. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS’s “Brazing Handbook,” “Pipe and Tube” Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.

G. Flared Joints: Comply with SAE J513. Tighten finger tight, then use wrench according to fitting manufacturer’s written recommendations. Do not over tighten.

H. Fiberglass-Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer’s written instructions.

3.08 FUEL-OIL AST INSTALLATION

A. Fuel Oil Tank Requirements: Provide fuel oil tanks in accordance with following:
   1. NFPA 30 and NFPA 30A.
   2. Manufacturer’s instructions.
   3. International Fire Code, Chapters 27 and 34.
   4. API RP 1615.
   5. Clean and flush tanks prior to delivery to site. Seal until pipe connections are made.
   6. Pipe Connections: Provide piping connections to tanks with unions and swing joints. Provide venting to API 2000.
   7. Wiring: Provide wiring and conduit for gauge and monitor; run wiring in electrical conduit. See electrical sections of this Project Specification for product and installation requirements.
   8. Cleaning: Clean and flush day tank after installation. Seal until pipe connections are made.
   9. Fuel Oil: Fill each tank and verify high-level alarm functions. Verify overfill protection device functions. Contracting Agency will provide product.

B. Tank Supports: Install tank bases and supports. Mount aboveground tanks on steel support saddles and stands.

C. Piping Connections: Connect piping and vent fittings.

D. Grounding: Install ground connections.

E. Leak Detection: Install tank leak-detection and monitoring devices.

F. STI R912: Install steel ASTs according to STI R912.

G. STI R942: Install insulated and concrete-vaulted steel ASTs according to STI R942.

H. Fill Tanks: Fill storage tanks with fuel oil. Contracting Agency will provide product. Verify high-level alarm functions. Verify overfill protection device functions.

I. Additional Venting: Provide aboveground storage tanks with additional venting that shall relieve excessive internal pressure caused by exposure to fire as required by International Fire Code 3404.2.7.4. Underground storage tanks shall meet requirements of International Fire Code 3404.2.11.

3.09 LIQUID-LEVEL GAUGE SYSTEM INSTALLATION

A. Liquid Level Gauge: Install liquid-level gauge system. Locate panel inside building where indicated.

3.10 LEAK-DETECTION AND MONITORING SYSTEM INSTALLATION

A. General: Install leak-detection and monitoring system. Install alarm panel inside building where indicated.
   1. Double-Wall, Fuel-Oil Storage Tanks: Install probes or use factory-installed integral probe in interstitial space.
   2. Double-Containment, Fuel-Oil Piping: Install leak-detection sensor probes in fuel-oil storage tank containment sumps and at low points in piping
   3. Install liquid-level gauge.

3.11 CONNECTIONS

A. Location: Install piping adjacent to equipment to allow service and maintenance.

B. Unions: Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.

C. Flanges: Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

D. Equipment Connections: Connect piping to equipment with ball valve and union. Install union between valve and equipment.

E. Flexible Piping Connections: Install flexible piping connectors at final connection to burners or oil-fired appliances that must be moved for maintenance access.

3.12 LABELING AND IDENTIFYING

A. General: Nameplates, pipe identification, and signs are specified in Section 23 05 53 “Identification for HVAC Piping and Equipment.”

B. Buried Fuel Oil Piping and Tanks:
   1. Piping: Over underground fuel oil distribution piping. Detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3.00 inches minimum width, yellow in color, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall read “CAUTION – BURIED FUEL OIL PIPING BELOW.” Provide permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material. Bury tape with printed side up at a depth of 12.00 inches below top surface of earth or top surface of sub-grade under pavements, except 6.00 inches below sub-grade under pavements and slabs. Terminate tracer wire in an accessible area and identify as “tracer wire” for future use with plastic-laminate sign.
   2. Fuel Oil Storage Tanks: Install two-dimensional grid of warning tape at 12.00 inches on center over each UST.
   3. Buried Fuel Oil Storage Tank Identification: Label fill reports and access manholes associate with underground storage tanks. Provide permanent labeling in the form of engraved or painted lettering. Labeling is to include the tank identification tag and the product stored in the tank.

3.13 FIELD PAINTING OF AST

A. General: Prepare and touch up damaged exterior surface of AST and supports as specified in “Shop Painting of AST” Specification.

B. Preparation: Prepare exterior steel surface of AST and tank supports.

C. Field Cleaning: After fabrication, blast clean according to SSPC-SP 6/NACE No. 3

D. Final Cleaning: After cleaning, remove dust or residue from cleaned surfaces.

E. Rust: If surfaces develop rust before prime coat is applied, repeat surface preparation.

F. Surface Preparation and Finish: Prepare surface of AST and supports and apply painting systems according to specifications in Section 09 96 00 “High-Performance Coatings” for severe environment high-gloss finish for ferrous metal.

3.14 FIELD PAINTING OF ABOVEGROUND PIPING

A. General: Comply with requirements in 09 90 00 "Painting and Coating" for painting interior and exterior fuel-oil piping.

B. Exposed Exterior Piping: Paint exposed, exterior metal piping, valves, and piping specialties, except components with factory-applied paint or protective coating.
   1. Alkyd System: MPI EXT 5.1D.
      a. Prime Coat: Alkyd anticorrosive metal primer.
      b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
      c. Topcoat: Exterior alkyd enamel (gloss).
      d. Color: Gray.

C. Exposed Interior Piping: Paint exposed, interior metal piping, valves, and piping specialties, except components with factory-applied paint or protective coating.
   1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
      a. Prime Coat: Alkyd anticorrosive metal primer.
      b. Intermediate Coat: Interior latex matching topcoat.
      c. Topcoat: Interior latex (gloss).
      d. Color: Gray.
   2. Alkyd System: MPI INT 5.1E.
      a. Prime Coat: Alkyd anticorrosivemetal primer.
      b. Intermediate Coat: Interior alkyd matching topcoat.
      c. Topcoat: Interior alkyd (gloss).
      d. Color: Gray.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.15 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer’s written instructions and according to seismic codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4.00 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18.00-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer’s setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Use 3,000-psig, 28-day, compressive-strength concrete and reinforcement as specified in Section 03 30 00 “Cast-in-Place Concrete.”

3.16 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

3.17 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
   1. NFPA: Testing shall be in accordance with NFPA 30 and NFPA 31.
   2. Testing: Prior to application of test pressure, remove or valve off piping components that may be damaged by test and provide a calibrated test gauge in system. Maintain test pressure for at least one hour. In event of leakage, locate and repair leak by re-welding and repeat test. Materials and equipment shall be subject to inspection at installation site by Contracting Agency.

B. Piping Test: Before final acceptance of Work, test each system as if in service to demonstrate compliance with Contract requirements. Furnish electricity, instruments, connecting devices, and personnel for tests. Correct defects in Work provided by Contractor and repeat tests until work complies with Contract requirements. Contracting Agency will furnish fuel for pipe testing and flushing provided by Contractor. Contractor shall be responsible for test fuel losses greater than 10 percent.

C. Pneumatic Test: Pneumatically test each pipe system to 25 psig and examine joints with soap solution. Gradually increase to 50 psig and hold for one hour.

D. Hydrostatic Tests: Upon completion of pneumatic testing, hydrostatically test each pipe system at 1.5 times maximum system operating pressure, but in no case more than 275 psig in accordance with ASME B31.3 and API RP 1110, with no leakage or reduction in gauge pressure for four hours.

E. Flushing: Thoroughly flush piping before placing in operation. Flush piping, including branch piping, at a minimum velocity of 8.00 feet per second.

F. Secondary Containment Piping Test: Secondary containment piping system shall undergo a 3 to 5-psi minimum air pressure/soap test upon completion of installation to confirm secondary containment integrity. This testing shall comply with manufacturer's published installation instructions.

G. Protective Coating Systems: Inspect protective coating systems with a holiday tester just prior to placement in ground. Holidays revealed shall be promptly repaired. Steel piping coating system shall be given a holiday test with a voltage of 100 to 200 times mil thickness of coating.

H. Steel Fuel Oil Storage Tanks: Test tanks for leaks by applying internal air pressure and using soapsuds, linseed oil, or equivalent material on external welds. For horizontal tanks, test pressure shall be not less than 3 or more than 5 psig. For vertical tanks, test pressure shall be not less than 1.50 psig or more than 2.50 psig. During testing, tank shall be provided with a pressure relief device. Pressure testing shall be for duration of one hour, or for the duration specified in the listing procedures of the specific manufacturer's tank.

I. Leak Detection: Test leak detection monitoring system in accordance with manufacturer's testing procedure.

J. Additional Tests and Procedures:
   1. Inspect and test fuel-oil piping according to NFPA 31, "Tests of Piping" Paragraph; and according to requirements of authorities having jurisdiction.
   2. Test liquid-level gauge for accuracy by manually measuring fuel-oil levels at not less than four different depths while filling tank and checking against gauge indication.
   3. Test leak-detection and monitoring system for accuracy in accordance with manufacturer's testing procedures and by manually operating sensors and checking against alarm panel indication.
   4. Start fuel-oil transfer pumps to verify for proper operation of pump and check for leaks.
   5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   6. Bleed air from fuel-oil piping using manual air vents.

K. Fuel Oil System Minimum Requirements: Fuel-oil piping and equipment will be considered defective if it does not pass tests and inspections.

L. Test and Inspection Reports: Prepare test and inspection reports.

3.18 OUTDOOR PIPING SCHEDULE

A. Underground Fuel-oil Piping shall be one of the Following: Size indicated is carrier-pipe size.
   1. Flexible, double-containment piping.
   2. Rigid, double-containment piping.

B. Underground Fuel-Oil-Tank Fill and Vent Piping shall be the Following:
   1. NPS 2 and Smaller: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints. Coat pipe and fittings with protective coating for steel piping.
   2. NPS 2-1/2 and Larger: Steel pipe, steel welding fittings, and welded joints. Coat pipe and fittings with protective coating for steel piping.

C. Aboveground Fuel-Oil Piping shall be the Following:
   1. NPS 2 and Smaller: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints.

3.19 ABOVEGROUND MANUAL FUEL-OIL SHUTOFF VALVE SCHEDULE

A. Distribution Piping Valves for Pipe NPS 2 and Smaller shall be the Following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.

B. Valves in Branch Piping for Single Appliance shall be the following:
   1. Two-piece, full-port, bronze ball valve with bronze trim.

3.20 DEMONSTRATION

A. General: Engage a factory-authorized service representative to train Contracting Agency's maintenance personnel to adjust, operate, and maintain liquid-level gauge systems, leak-detection and monitoring systems, fuel-oil pumps.

END OF SECTION 33 52 10

This page intentionally left blank

SECTION 41 23 13.13
BRIDGE CRANE EQUIPMENT

PART 1 GENERAL

1.01 FURNISHED BY CONTRACTOR INSTALLED BY CONTRACTOR (FCIC)

A. Bridge Cranes shall be Furnished by Contractor, Installed by Contractor (FCIC).

1.02 RELATED DOCUMENTS

A. Equipment items are listed below by Equipment I.D. Tag.
   1. Bridge Crane 10 ton,
      a. Repair and Fabrication Shop Equipment I.D. Tag: FS-17 (Qty. (1)
   2. Bridge Crane 1.5 ton,
      a. Snow Plow Removal/Install Equipment I.D. Tag: SP-01 (Qty. (1)

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.03 SUMMARY

A. The work required under this section shall include the designing, manufacturing, shipping, installation and field testing of a top running, single girder, overhead traveling bridge crane with one trolley hoist.

B. Related Sections:
   1. Structural Steel
   2. Special Coating
   3. Electrical Requirements
   4. Basic Electrical Materials and Methods

1.04 REFERENCES

A. Crane Manufacturers Association of America (CMAA)
   1. Specification No. 70 for Top Running & Under Running Single Girder Electric Overhead Traveling Cranes.

B. American National Standard (ANSI)
   1. ANSI B-30.16 Overhead Hoists

C. Occupational Safety and Health Administration (OSHA)
   1. Par. 1910.179 Overhead & Gantry Cranes

D. Hoist Manufacturers Institute (HMI)

E. National Electric Code (NEC)
   1. NEC (Latest Edition Article 610 Cranes and Hoists)

F. American Institute of Steel Construction (AISC)

G. Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings

H. American Society for Testing and Materials (ASTM)
   1. A36/A36M - Specification for Carbon Structural Steel

I. American Welding Society (AWS)
   1. D1.1 - Structural Welding Code - Steel
   2. D14.1 - Overhead Cranes

1.05 SUBMITTALS

A. Shop Drawings and Equipment Data
   1. Submit for approval, Shop Drawings showing complete details and dimensions.
   2. Manufacturers catalog data.
   3. Wiring schematics – ship with crane

B. Operation and Maintenance Manuals
   1. Equipment function, normal operating characteristics, and limiting conditions.
   2. Assembly, installation, alignment, and maintenance instructions. +

3. Lubrication and maintenance instructions.
4. Guide to “troubleshooting”.
5. Parts list.
6. As-built drawing.
7. Test results.

C. Manufacturer’s Reference:

1. Prime Manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

   Kone Cranes Inc.

   8735 S 212th Street

   Kent, WA 98031-1921

   Phone: (253) 872-9696

   Website: https://www.konrcranes.com/

   10ton (20,000 lbs.) Overhead Bridge Crane Model:

   Repair / Fabrication Shop: CXTSke10-TON

   1.5ton (3,000 lbs.) Underhung Bridge Crane Model:

   Medium to Large Covered Packing Structure: CXT1.5-TON

D. Other manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers may be considered as equal.

1.06 QUALITY ASSURANCE

A. Manufacturers shall have documented experience for ten (10) years, having successfully designed and built installations of similar scope.

B. Manufacturer shall be responsible for providing equipment of highest quality and workmanship that will perform specific functions reliably and safely.

1.07 PROJECT CONDITIONS

A. Examination of Site: The Subcontractor shall examine the site and become familiar with all conditions that may affect the work covered by the specifications. Failure to do so shall not lessen the subcontractor’s responsibility or entitle the Subcontractor to additional compensation for work not included in the bid.

1.08 WARRANTY

A. Warranty and Maintenance services shall be provided by the Subcontractor at no additional cost to the Owner for one (1) year after final system acceptance. These services shall consist of manufacturer’s factory-trained representatives providing emergency repair service with on-site response within 24 hours of call, all test equipment and hardware necessary for maintenance and repair work and installation of any hardware modifications designed to improve system performance or eliminate known problems or deficiencies.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hoists, trolleys, bridge end trucks, drives and controls shall all be from one suppler and shall meet the requirements of this specification.

2.02 CRANE SUMMARY

A. Bridge Crane #1, Bldg. C Fabrication Shop (Qty 1) Equipment Tag # FS-17

1.	Capacity:	10-Tons
2.	Duty Class:	CMAA Class C
3.	Span:	29’-6” (See Structural for Final)
4.	Runway Length	48’-6”
5.	Steel:	AISC Hot Rolled WF Shapes

6. Bridge Girder Deflection: L/600
7. End Trucks: Dual drive with rotating axles. Motors shall include AC magnetic disc brakes per CMAA requirements.
8. Hoist: 10-ton, Electric wire rope hoist
9. Lift: 20'-0”
10. Trolley: Motor driven with drive wheels each side and AC magnetic brakes per CMAA requirements.
11. Trolley Speed: 0 - 65 ft/min stepless (variable frequency drive)
12. Hoist Speed: 20 / 3.3 ft/min two speed contactor control
13. Bridge Speed 0 – 100 ft/min stepless (variable frequency drive)
14. Voltage: 480 V 3 Ph 60 Hz, 115-volt control.
15. Environment: Normal, indoor application.
16. Bumpers: Rubber bumpers on end trucks and trolley per CMAA requirements.
17. Limit Switches: Hoist with geared upper and lower limit switch and block operated upper limit, overload limit switch set at 115% of full load. Trolley and bridge with travel limit switches.

B. Bridge Crane #2, Snow Plow Removal/Install (Qty 1) Equipment Tag #SP-01
1. Capacity: 1.5-Tons
2. Duty Class: CMAA Class C
3. Span: 8’-0” (See Structural for Final)
4. Runway Length 234’-0”
5. Steel: AISC Hot Rolled WF Shapes
6. Bridge Girder Deflection: L/600
7. End Trucks: Dual drive with rotating axles. Motors shall include AC magnetic disc brakes per CMAA requirements.
8. Hoist: 2-ton, Electric wire rope hoist
9. Lift: 20'-0”
10. Trolley: Motor driven with drive wheels each side and AC magnetic brakes per CMAA requirements.
11. Trolley Speed: 0 - 65 ft/min stepless (variable frequency drive)
12. Hoist Speed: 6.5 ft/min stepless (With ASR 15 ft/min)
13. Bridge Speed 0 – 100 ft/min stepless (variable frequency drive)
14. Voltage: 480 V 3 Ph 60 Hz, 115-volt control.
15. Environment: Normal, indoor application.
16. Bumpers: Rubber bumpers on end trucks and trolley per CMAA requirements.
17. Limit Switches: Hoist with geared upper and lower limit switch and block operated upper limit, overload limit switch set at 115% of full load. Trolley and bridge with travel limit switches.

2.03 RUNWAY ELECTRIFICATION

A. The runway conductors shall be Figure-8, rolled galvanized steel bar as supplied by Duct-o-wire Corporation. The minimum capacity of the conductor bar shall be sized to carry the necessary ampere load without undue heating.

B. Four-conductor configuration shall be provided with all brackets, hangers, splice covers, power feeds, expansion gap assemblies and collectors as required by Conductix, Insul8 or Duct-o-wire.

2.04 RUNWAY BEAMS AND RAILS

A. Runway supports, runway beams and end stops shall be supplied and installed by the metal building provider and are not included in this section.

B. Rails shall be ASCE rails, sized according to the crane wheel loads and shall be supplied and installed by the crane manufacturer.

C. The runway rails shall be attached to the runway beams using hook bolts, rail clips or clamps, as determined by the crane manufacturer.

2.05 EQUIPMENT

A. Hoist and Trolley
   1. Top riding single girder crane shall utilize the CXT low head room trolley hoist as manufactured by Konecranes, Inc.
   2. The hoist shall be equipped with an electro-mechanical load-limiting device that shall prevent lifting more than 115% of the rated load.
   3. Hoisting motor(s) shall be two-speed/two winding squirrel cage type with a speed ratio of 6:1.
   4. Hoisting motor(s) shall be totally enclosed with IP55 protection, minimum class F insulation, Klixon type bimetal switch for thermal protection and shall have a 60% ED rating.
   5. Trolley shall be furnished with an adjustable frequency inverter drive and two-step or infinitely variable speed control for smooth acceleration and deceleration.
   6. Trolley motors shall be inverter duty motors with minimum class “F” insulation and motor enclosures shall be TENV [totally enclosed non-ventilated].
   7. Rotary cam type limit switch equipped with 4 micro-switches shall be provided. Limit switch shall provide upper and lower limit of hoist travel, hoist slow down prior to reaching upper limit and phase sequence supervision at upper limit.
   8. Hoist motor brake shall be DC disc type with adequate torque to stop and hold over 125% of the hoist rated load.
   9. Large diameter rope drum with minimum of 36:1 drum to wire rope diameter ration. Groove depth shall be at least 35% of rope diameter. The rope drum shall be equipped with a rope guide to help keep the rope aligned in the grooves of the drum.
   10. Wire rope shall be constructed from galvanized steel having a minimum safety factor of 5.
   11. Hoist reeving shall be single reeved. Lateral hook drift shall not exceed 1/8 inch per foot of vertical travel on single reeved models.
   12. The hoist nameplate is to carry a CSA US rating. The actual hoist control enclosure rating shall be at least equivalent to IP55 / NEMA 4 type.
   13. Hooks shall be made of forged alloy steel and shall be fitted with a spring-loaded flipper-type safety latch.
   14. Hoist shall have a duty rating suitable for the load class and load cycles of the application (reference appendix A).
   15. AGMA quality class 12 machine cut, hardened and precision ground hoist gearing. The gears inside the hoist gearboxes on models up to 5-ton capacity are lubricated by semi-fluid grease. On models over 5-ton capacity the gears inside the hoist gearbox are lubricated with semi-fluid grease or oil.
   16. AGMA quality class 10, hardened and precision ground trolley drive gearing, lubricated by semi-fluid grease.
   17. Trolleys shall have safety drop lugs and energy absorbing bumpers.

B. Bridge Girder
   1. Bridge girders shall be constructed from welded box girders or Structural beams, Steel, ASTM A36, A50 or A992, as required.

C. End Trucks and Bridge Drive
   1. End trucks shall be designed in accordance with CMAA specifications as applicable for the type crane.
   2. End trucks shall be bolted (not welded) to bridge girder.
   3. Bridge drive shall be dual motor (A-4 arrangement per CMAA)
   4. Bridge drive shall be designed to stop bridge within CMAA specifications.
   5. End trucks shall be equipped with rail sweeps and energy-absorbing rubber bumpers.
   6. Travel limit switches to be provided as necessary for safe operation.
   7. Bridge shall be furnished with an adjustable frequency inverter drive and two-step or infinitely variable speed control for smooth acceleration and deceleration.
   8. Bridge motors shall be inverter duty motors with minimum class “F” insulation and motor enclosures shall be TENV [totally enclosed non-ventilated].
   9. AGMA quality class 10, hardened and precision ground bridge drive gearing, lubricated by semi-fluid grease.

10. Bridge girder shall be per 1.01B above, as applicable.
11. Bridge girders shall be constructed from welded box girders or Structural beams, Steel, ASTM A36 A50 or A992, as required.

D. Power Supply
1. Power supply for the hoist shall be 480 Volt, 3 Phase, 60 Hz. All power required for the operation of the hoist, trolley, and end trucks shall be developed from this source.
2. Runway electrification shall be 4-bar safety type rigid conductors as manufactured by Insul-8, Duct-O-Wire Company or Wampfler. Wall mounted disconnect switch and power to runway conductors provided by Electrical Contractor.
3. Cross bridge electrification shall be flat cable style festoon system with terminal box, multi-conductor cord, plug connectors (when available) and accessories. Cables are to be hardwired when plug connectors are not available.

E. Controls
1. Six-way operation, plug-in pushbutton pendant suspended from independent festoon track.
2. Pendant shall include Start (momentary) button, Emergency Stop (push to maintain-turn to release) that controls a mainline contactor in the bridge panel.
3. Pushbutton shall be clearly marked with hoist, trolley and bridge travel directions.
4. Hoist shall be 2 speed magnetic reversing type (standard) or variable frequency inverter control (optional) and the trolley and bridge controls shall be variable frequency inverter control (standard).
5. Electrical control enclosures shall be IP55 or NEMA 4 type. Pushbutton enclosure shall be non-corrosive, nonconductive and have a rating of IP65, NEMA 4X, 4 or 5.

PART 3 EXECUTION

3.01 INSTALLATION AND INSPECTION (IF APPLICABLE TO MANUFACTURER)

A. Inspect structure and crane rail erection for conformance with reviewed shop drawings and contract documents prior to installation of equipment. Bring nonconforming work to the attention of the customer prior to proceeding with crane installation. Non-conforming runway structure or installation must be corrected prior to load testing of crane system. Costs of delays or additional work due to nonconforming runway structure will be reimbursed by the Owner.

B. Bridge crane shall be installed in conformance with manufacturer's instructions and inspected by a manufacturer's representative. Provide all necessary accessories to make bridge crane complete, usable, and capable of meeting the operating requirements specified in the Operating Requirements. Test, adjust and clean equipment for acceptance by Owner.

3.02 TESTING

A. All crane equipment shall be operated through a complete lift and lowering cycle and through a complete travel of the bridge and trolley to determine that the equipment shall perform smoothly and safely and that pendant cable length is sufficient to permit operation from desired floor levels. All tests shall be carried out with the bridge crane equipment loaded at 100 percent of capacity, not to exceed 125 percent of capacity. The bridge crane provider shall provide the test weight loads. Any defects shall be corrected by the bridge crane provider without any expense to the Owner.

END OF SECTION 41 23 13.13

This page intentionally left blank

SECTION 44 13 20
MOBILE FUME EXTRACTOR EQUIPMENT

PART 1 GENERAL

1.01 FURNISHED BY CONTRACTOR INSTALLED BY CONTRACTOR (FCIC)

A. Mobile Fume Extractor Equipment shall be Furnished by Contractor, Installed by Contractor (FCIC)

1.02 SYSTEM DESCRIPTION

A. Equipment item is listed below by Equipment I.D. Tag.
   1. Mobile Fume Extractor.
      a. Equipment I.D. Tag: FS-16 (Qty. 1)

B. Mobile Fume Extractor Equipment (s)
   1. This section includes the specifications for the Mobile Fume Extractor Equipment (s) being installed for removal of the outgassing from welding repair work, across the site and areas as noted in the Bid Specifications and Bid Drawing Package.
      a. Mobile Fume Extractor Equipment – Description of System(s)
         1) The configurations for Mobile Fume Extractor are described below.
            (a) Standalone equipment for mobile repair services on an assortment of Cars and Light / Heavy Duty Trucks.

C. Seismic Calculations
   1. For seismic calculations, Reference general seismic design criteria noted on Sheet S0.1 Division 1 – General, A.9.

D. List of Applicable Forms
   1. The General Conditions, Supplementary Conditions, Instructions to Bidders, Bid Form, all apply to these bid items.

1.03 DESCRIPTION OF WORK

A. List of Work
   1. The extent of the Work is shown on the drawings and is defined to include (but not by way of limitations) all labor, materials, freight, unloading, equipment, taxes, permits and supervision required for equipment and installation.

B. Coordination
   1. Contractor’s Responsibility: It will be the Contractor's responsibility to verify and establish a detailed installation schedule.
   2. Field Check: ALL BUILDING AND EQUIPMENT LAYOUT DIMENSIONS SHALL BE FIELD CHECKED AND VERIFIED BY CONTRACTOR PRIOR TO START OF INSTALLATION. NOTIFY THE CONSULTANT AND OWNER OF ANY DISCREPANCIES OR CONDITIONS AFFECTING MATERIALS AND/OR INSTALLATION WITHIN TEN (10) DAYS. IF A CONDITION EXISTS AND THE CONSULTANT OR OWNER IS NOT NOTIFIED THE ADDITIONAL COST TO CORRECT THE INSTALLATION IN ACCORDANCE WITH THE REQUIREMENTS OF THE OWNER WILL BE THAT OF THE CONTRACTOR.
   3. Delivery and Unloading: The Mobile Fume Extractor Contractor shall be responsible for coordinating the delivery and unloading of the equipment to the job-site with the General Contractor to eliminate demurrage charges, unless authorized by the Owner or the Consultant. In order to eliminate disruption to the ongoing operations and prevent interference of dock access by trucks entering and leaving the site, temporary staging of materials will be provided outside of the building at a location designated by the Owner. The Mobile Fume Extractor Contractor shall provide storage facilities (i.e., covers, closed containers) to protect equipment from the elements (i.e., dust, dirt, rain, ice, snow, etc.) as necessary. Interior staging of equipment will be kept to a minimum so as not to disrupt ongoing operations.

1.04 QUALITY ASSURANCE

A. Standards
   1. Equipment Standards: The equipment covered by these Specifications shall be designed, assembled, tested and installed in accordance with the latest applicable standards, including:
   2. American National Standards Institute (ANSI).
   3. International Building Code (IBC)
      a. International Building Code including current Building Code Amendments. (2015 Edition)
   4. Materials
      a. All materials furnished shall be new, free from defects, and UL-Approved where such approval is granted to the equipment to be furnished.
   5. Federal Inspection
      a. Latest published applicable Federal Specifications.
   6. OSHA
      a. Applicable OSHA Specifications.
   7. Building and Safety Codes
      a. Any applicable local building and safety codes pertaining to the Work.

B. Workmanship
   1. Trade Methods: Use the best trade methods throughout. Work evidencing substandard workmanship shall be corrected or replaced by the Contractor at the Contractor's expense, per the General Conditions.

C. Touch Up Paint: The method for the touch up of paint shall follow specifications section 3.02 Field Painting.

D. Guarantees
   1. WARRANTY:
      a. Warranty shall be the manufacturer's standard warranty and shall be specified by the Contractor in the contents of the proposal.
      b. The contractor shall provide an extended warranty for a period of three (3) years from Date of Acceptance.
      c. QUALITY OF MATERIALS AND EQUIPMENT: The Contractor guarantees the material and equipment delivered under the Contract to be free from defects in design or workmanship and against damages caused prior to final inspection. Unless otherwise specified, this guarantee extends for a period of three (3) years from the Date of Acceptance for both labor and materials.
      d. REPAIRING DEFECTS: The Contractor shall promptly repair or replace all defective or damaged items delivered under the Contract. The Mobile Fume Extractor Contractor may elect to have any replaced item returned to his/her plant at his/her expense.

1.05 SUBMITTALS

A. Product Data: Submit latest edition of Mobile Fume Extractor data sheet and outline drawing with the proposal.

B. Shop Drawings:
   1. Shop Drawings, as stated in the General Conditions, shall include, but need not be limited to:
   2. Installation Plan: Proposed installation plan of equipment, including location and dimensions of new equipment clearly identified. It will be the Contractor's responsibility to verify and establish a detailed installation schedule per the General Conditions.
   3. Dimensions: Plan views showing all equipment dimensions along with any aisle clearance dimensions.
   4. Bill of Materials: Bill of Materials per the General Conditions.
   5. Approved Shop Drawings
   6. It will be the Contractor's responsibility to obtain approved shop drawings signed by the Consultant and/or Owner per the General Conditions prior to fabrication.

C. Manufacturer's Reference:
1. Prime Manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

IAP Air Products

2544 Highway 70 East

Cookeville, TN 38506

Phone: (888) 372-0050

Website: https://www.IAP-AirProducts.com/

Mobile Fume Extractor Model: Boxair M1 unit with FA-0610-S 6"x10' Fume Arm.

D. Other manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers may be considered as equal.

PART 2 PRODUCTS

2.01 MOBILE FUME EXTRACTOR EQUIPMENT GENERAL

A. The Contractor shall provide the following:
1. List of Required Items
a. New Mobile Fume Extractor as shown on the drawings, including freight, unloading, installation, touch-up painting, cleaning, and other equipment necessary to complete the system.

B. Quantity and Capacity
1. See drawings for equipment location and configuration.

C. Standard Designs
1. Components shall be of standard design and fabrication by the manufacturer so that all may be replaced or purchased at a future date without special charges or extended deliveries.

D. The Bill of Materials for this Work is to be determined by the Contractor from the bid drawings and contents of the Specifications. Mobile Fume Extractor Contractor to verify all information.

E. Codes
1. The Mobile Fume Extractor shall be designed and installed to the exact standards of the manufacturer and in all cases shall conform to applicable codes.

F. Install
1. The shipment of the Mobile Fume Extractor shall include all components to allow immediate install upon receipt.

G. Touch Up
1. The Mobile Fume Extractor Contractor shall touch up any other Contractor's work damaged during the process per section 3.02 Field Painting.

2.02 MOBILE FUME EXTRACTOR

A. General: Equipment Tag # FS-16 Mobile Fume Extractor (Qty. 1)
1. Description: Mobile Fume Extractor typically used in commercial Vehicle Maintenance and Repair Shops for capturing outgassing byproduct from the welding process.
2. Physical Data:
a. Overall Dimensions:
1) Width: 31"
2) Length: 50"
3) Overall Length: 65"
b. Nominal Airflow: 700 cfm
c. Motor: 1.5 hp
d. Compressed Air: 90 psi
e. Power Requirements: 120V, 50/60 Hz 1ph

f. Fume Arm Inlet Plate: 6”
g. Fume Arm: 6”x10’

B. Features and Construction:
1. Filtration Efficiency: 99.9%
2. Filter Gauge: Integrated
3. Three Filters: Washable Pre-Filter, Cartridge
4. Decibel Rating: 74dB@3 ft / 72.5dB@6.5ft / 71db@10ft
5. Manual air pulse jet cartridge cleaning system
6. Dust Drawer
7. Casters and Brakes
8. 2-year Manufacturer’s warranty

C. Finish: Manufactures Standard

PART 3 EXECUTION

3.01 EXAMINATION

A. Coordination
1. Each Contractor must give careful consideration to the ongoing facility operations and the work of other contractors during the entire project and shall organize his/her work so that it will not interfere with ongoing operations or interfere with or delay the work of others. Minimal disruption to ongoing operations is a priority. It is imperative that the schedule be maintained with any changes coordinated promptly with the General Contractor, Owner, and Consultant.

B. General Description
1. The Mobile Fume Extractor shall be installed complete in all details and in accordance with the specifications, manufacturer's recommendations, and the drawings.

C. Installation Routine
1. Installation shall include unloading, checking and security of equipment prior to installation, touch up and cleaning. The Contractor shall provide storage facilities (i.e., covers, closed containers) to protect equipment from the elements (i.e., dust, dirt, rain, snow, etc.). Contractor shall use a transfer system to bring materials inside the building that is supplied by the Contractor. Contractor to ensure no damage to the overhead door, floor, facility or equipment.

D. Tools and Equipment
1. The Contractor shall be responsible to provide all tools and equipment necessary for a complete and satisfactory installation.

E. Permits and Inspection (as required)
1. Contractor shall obtain, and pay for, all necessary permit fees and inspections required by the State or local municipalities.

F. Damaged Materials
1. Claims, due to freight damage, are the responsibility of Mobile Fume Extractor Contractor. This includes any damage that is not evident at the time of the unloading of the equipment (i.e., concealed damage). Should such damage be uncovered, the Contractor must act promptly to repair/replace damaged equipment to minimize any delay to the schedule. Any added cost due to a delay is the responsibility of the Contractor.

G. Debris Disposal
1. It shall be the responsibility of the Mobile Fume Extractor Contractor to remove any debris resulting from his/her work on each and every workday to a pre-designated disposal area. This shall include all waste generated by the installer or any of his/her personnel, shipping containers, and/or construction materials. The Contractor shall broom clean the area each work day to leave the work area clean and allow the Owner access to scrub the floor. This will include organizing the materials not yet incorporated in the Work. At the completion of the work the Contractor shall remove all of his/her waste materials and rubbish from and about the project, as well as all his/her tools.

H. Clearance
   1. The Contractor shall be responsible for maintaining all clearances specified on the drawings.

I. Modifications
   1. The Contractor shall be responsible for the suitability of any Mobile Fume Extractor component modifications required after installation begins. All modifications must be submitted and approved by the Owner and Consultant prior to beginning Work. Modifications done by others must be approved by the Contractor prior to modification. The Contractor shall be responsible for such a modification by others.

J. Contractor's Survey of Damage
   1. The Contractor shall conduct a survey of his/her work each and every workday morning and note any and all damages observed. Any damages must be reported to the General Contractor and the Owner by 9:00 a.m. Damages not reported within this time frame will be the contractor's responsibility.

3.02 FIELD PAINTING

A. Cleaning
   1. All surfaces to be painted must be thoroughly cleansed of rust, scale, oil, grease, dirt, welding flash and all other forms of dirt detrimental to good painting practices.

B. Touch-Ups
   1. After the installations are complete, the Contractor shall touch-up any components that were damaged but only with owners/representative approval. Finish to match factory finish.

END OF SECTION 44 13 20

This page intentionally left blank

KITSAP COUNTY DEPARTMENT OF PUBLIC WORKS
COUNTY ROAD PROJECT NO. 1632

NORTH KITSAP SERVICE CENTER

VOLUME 3 OF 3

APPENDICES

KITSAP COUNTY DEPARTMENT OF PUBLIC WORKS
614 DIVISION STREET, MS-26
PORT ORCHARD, WASHINGTON 98366-4699
360.337.5777

BACK OF COVER

KITSAP COUNTY PUBLIC WORKS
NORTH KITSAP SERVICE CENTER

VOLUME 3 OF 3

APPENDICES

Appendix A **Washington State Prevailing Wage Rates for Public Works Contracts**

Appendix B **North Kitsap Service Center, Geotechnical Engineering Report Exploration Logs, Aspect Consulting, November 2022**

Appendix C **Contracting Agency-Furnished Permits**

- Kitsap Health District Health Officer Decision for Onsite Sewage System
- Washington State Department of Transportation, General Permit
- Kitsap County Department of Community Development, Site Development Activity Permit (SDAP) 22-03979 Plan Acceptance
- Kitsap County Department of Community Development, Notice of Administrative Decision for Administrative Conditional Use Permit (ACUP)
- Washington State Department of Ecology, Coverage under the Construction Stormwater General Permit

Appendix D **Example Baseline Schedule of Values**

Appendix E **Appraisal of Timber, S. A. Newman Firm, August 2018**

Appendix F **Kitsap Public Utility District Standard Plans**

This page intentionally left blank

Appendix A

Washington State Prevailing Wage Rates for Public Works Contracts

This page intentionally left blank

State of Washington
Department of Labor & Industries
Prevailing Wage Section - Telephone 360-902-5335
PO Box 44540, Olympia, WA 98504-4540

Washington State Prevailing Wage

The PREVAILING WAGES listed here include both the hourly wage rate and the hourly rate of fringe benefits. On public works projects, worker's wage and benefit rates must add to not less than this total. A brief description of overtime calculation requirements are provided on the Benefit Code Key.

Journey Level Prevailing Wage Rates for the Effective Date: 07/18/2023

County	Trade	Job Classification	Wage	Holiday	Overtime	Note	*Risk Class
Kitsap	Asbestos Abatement Workers	Journey Level	$56.80	5D	1H		View
Kitsap	Boilermakers	Journey Level	$74.29	5N	1C		View
Kitsap	Brick Mason	Journey Level	$66.32	7E	1N		View
Kitsap	Brick Mason	Pointer-Caulker-Cleaner	$66.32	7E	1N		View
Kitsap	Building Service Employees	Janitor	$15.74		1		View
Kitsap	Building Service Employees	Shampooer	$15.74		1		View
Kitsap	Building Service Employees	Waxer	$15.74		1		View
Kitsap	Building Service Employees	Window Cleaner	$15.74		1		View
Kitsap	Cabinet Makers (In Shop)	Journey Level	$23.72		1		View
Kitsap	Carpenters	Acoustical Worker	$71.53	15J	4C		View
Kitsap	Carpenters	Bridge, Dock And Wharf Carpenters	$71.53	15J	4C		View
Kitsap	Carpenters	Floor Layer & Floor Finisher	$71.53	15J	4C		View
Kitsap	Carpenters	Journey Level	$71.53	15J	4C		View
Kitsap	Carpenters	Scaffold Erector	$71.53	15J	4C		View
Kitsap	Cement Masons	Application of all Composition Mastic	$70.09	15J	4U		View
Kitsap	Cement Masons	Application of all Epoxy Material	$69.59	15J	4U		View
Kitsap	Cement Masons	Application of all Plastic Material	$70.09	15J	4U		View
Kitsap	Cement Masons	Application of Sealing Compound	$69.59	15J	4U		View
Kitsap	Cement Masons	Application of Underlayment	$70.09	15J	4U		View
Kitsap	Cement Masons	Building General	$69.59	15J	4U		View
Kitsap	Cement Masons	Composition or Kalman Floors	$70.09	15J	4U		View
Kitsap	Cement Masons	Concrete Paving	$69.59	15J	4U		View
Kitsap	Cement Masons	Curb & Gutter Machine	$70.09	15J	4U		View
Kitsap	Cement Masons	Curb & Gutter, Sidewalks	$69.59	15J	4U		View
Kitsap	Cement Masons	Curing Concrete	$69.59	15J	4U		View

Kitsap	Cement Masons	Finish Colored Concrete	$70.09	15J	4U		View
Kitsap	Cement Masons	Floor Grinding	$70.09	15J	4U		View
Kitsap	Cement Masons	Floor Grinding/Polisher	$69.59	15J	4U		View
Kitsap	Cement Masons	Green Concrete Saw, self-powered	$70.09	15J	4U		View
Kitsap	Cement Masons	Grouting of all Plates	$69.59	15J	4U		View
Kitsap	Cement Masons	Grouting of all Tilt-up Panels	$69.59	15J	4U		View
Kitsap	Cement Masons	Gunite Nozzleman	$70.09	15J	4U		View
Kitsap	Cement Masons	Hand Powered Grinder	$70.09	15J	4U		View
Kitsap	Cement Masons	Journey Level	$69.59	15J	4U		View
Kitsap	Cement Masons	Patching Concrete	$69.59	15J	4U		View
Kitsap	Cement Masons	Pneumatic Power Tools	$70.09	15J	4U		View
Kitsap	Cement Masons	Power Chipping & Brushing	$70.09	15J	4U		View
Kitsap	Cement Masons	Sand Blasting Architectural Finish	$70.09	15J	4U		View
Kitsap	Cement Masons	Screed & Rodding Machine	$70.09	15J	4U		View
Kitsap	Cement Masons	Spackling or Skim Coat Concrete	$69.59	15J	4U		View
Kitsap	Cement Masons	Troweling Machine Operator	$70.09	15J	4U		View
Kitsap	Cement Masons	Troweling Machine Operator on Colored Slabs	$70.09	15J	4U		View
Kitsap	Cement Masons	Tunnel Workers	$70.09	15J	4U		View
Kitsap	Divers & Tenders	Bell/Vehicle or Submersible Operator (Not Under Pressure)	$126.05	15J	4C		View
Kitsap	Divers & Tenders	Dive Supervisor/Master	$89.94	15J	4C		View
Kitsap	Divers & Tenders	Diver	$126.05	15J	4C	8V	View
Kitsap	Divers & Tenders	Diver On Standby	$84.94	15J	4C		View
Kitsap	Divers & Tenders	Diver Tender	$77.16	15J	4C		View
Kitsap	Divers & Tenders	Hyperbaric Worker - Compressed Air Worker 0-30.00 PSI	$89.09	15J	4C		View
Kitsap	Divers & Tenders	Hyperbaric Worker - Compressed Air Worker 30.01 - 44.00 PSI	$94.09	15J	4C		View
Kitsap	Divers & Tenders	Hyperbaric Worker - Compressed Air Worker 44.01 - 54.00 PSI	$107.09	15J	4C		View
Kitsap	Divers & Tenders	Hyperbaric Worker - Compressed Air Worker 54.01 - 60.00 PSI	$103.09	15J	4C		View
Kitsap	Divers & Tenders	Hyperbaric Worker - Compressed Air Worker 60.01 - 64.00 PSI	$105.59	15J	4C		View
Kitsap	Divers & Tenders	Hyperbaric Worker - Compressed Air Worker 64.01 - 68.00 PSI	$110.59	15J	4C		View
Kitsap	Divers & Tenders	Hyperbaric Worker - Compressed Air Worker 68.01 - 70.00 PSI	$112.59	15J	4C		View

Kitsap	Divers & Tenders	Hyperbaric Worker - Compressed Air Worker 70.01 - 72.00 PSI	$114.59	15J	4C		View
Kitsap	Divers & Tenders	Hyperbaric Worker - Compressed Air Worker 72.01 - 74.00 PSI	$116.59	15J	4C		View
Kitsap	Divers & Tenders	Manifold Operator	$77.16	15J	4C		View
Kitsap	Divers & Tenders	Manifold Operator Mixed Gas	$82.16	15J	4C		View
Kitsap	Divers & Tenders	Remote Operated Vehicle Operator/Technician	$77.16	15J	4C		View
Kitsap	Divers & Tenders	Remote Operated Vehicle Tender	$71.98	15J	4C		View
Kitsap	Dredge Workers	Assistant Engineer	$76.56	5D	3F		View
Kitsap	Dredge Workers	Assistant Mate (Deckhand)	$75.97	5D	3F		View
Kitsap	Dredge Workers	Boatmen	$76.56	5D	3F		View
Kitsap	Dredge Workers	Engineer Welder	$78.03	5D	3F		View
Kitsap	Dredge Workers	Leverman, Hydraulic	$79.59	5D	3F		View
Kitsap	Dredge Workers	Mates	$76.56	5D	3F		View
Kitsap	Dredge Workers	Oiler	$75.97	5D	3F		View
Kitsap	Drywall Applicator	Journey Level	$71.53	15J	4C		View
Kitsap	Drywall Tapers	Journey Level	$70.61	5P	1E		View
Kitsap	Electrical Fixture Maintenance Workers	Journey Level	$37.19	5L	1E		View
Kitsap	Electricians - Inside	Cable Splicer	$102.90	7C	4E		View
Kitsap	Electricians - Inside	Cable Splicer (tunnel)	$110.61	7C	4E		View
Kitsap	Electricians - Inside	Certified Welder	$99.38	7C	4E		View
Kitsap	Electricians - Inside	Certified Welder (tunnel)	$106.75	7C	4E		View
Kitsap	Electricians - Inside	Construction Stock Person	$49.28	7C	4E		View
Kitsap	Electricians - Inside	Journey Level	$95.88	7C	4E		View
Kitsap	Electricians - Inside	Journey Level (tunnel)	$102.90	7C	4E		View
Kitsap	Electricians - Motor Shop	Craftsman	$15.74		1		View
Kitsap	Electricians - Motor Shop	Journey Level	$15.74		1		View
Kitsap	Electricians - Powerline Construction	Cable Splicer	$93.00	5A	4D		View
Kitsap	Electricians - Powerline Construction	Certified Line Welder	$85.42	5A	4D		View
Kitsap	Electricians - Powerline Construction	Groundperson	$55.27	5A	4D		View
Kitsap	Electricians - Powerline Construction	Heavy Line Equipment Operator	$85.42	5A	4D		View
Kitsap	Electricians - Powerline Construction	Journey Level Lineperson	$85.42	5A	4D		View
Kitsap	Electricians - Powerline Construction	Line Equipment Operator	$73.35	5A	4D		View
Kitsap	Electricians - Powerline Construction	Meter Installer	$55.27	5A	4D	8W	View
Kitsap	Electricians - Powerline Construction	Pole Sprayer	$85.42	5A	4D		View

Kitsap	Electricians - Powerline Construction	Powderperson	$63.50	5A	4D		View
Kitsap	Electronic Technicians	Journey Level	$62.13	7E	1E		View
Kitsap	Elevator Constructors	Mechanic	$107.49	7D	4A		View
Kitsap	Elevator Constructors	Mechanic In Charge	$116.13	7D	4A		View
Kitsap	Fabricated Precast Concrete Products	Journey Level	$15.74		1		View
Kitsap	Fabricated Precast Concrete Products	Journey Level - In-Factory Work Only	$15.74		1		View
Kitsap	Fence Erectors	Fence Erector	$48.14	15J	4V	8Y	View
Kitsap	Fence Erectors	Fence Laborer	$48.14	15J	4V	8Y	View
Kitsap	Flaggers	Journey Level	$48.14	15J	4V	8Y	View
Kitsap	Glaziers	Journey Level	$75.91	7L	1Y		View
Kitsap	Heat & Frost Insulators And Asbestos Workers	Journey Level	$84.84	15H	11C		View
Kitsap	Heating Equipment Mechanics	Journey Level	$94.11	7F	1E		View
Kitsap	Hod Carriers & Mason Tenders	Journey Level	$59.85	15J	4V	8Y	View
Kitsap	Industrial Power Vacuum Cleaner	Journey Level	$29.89		1		View
Kitsap	Inland Boatmen	Boat Operator	$61.41	5B	1K		View
Kitsap	Inland Boatmen	Cook	$56.48	5B	1K		View
Kitsap	Inland Boatmen	Deckhand	$57.48	5B	1K		View
Kitsap	Inland Boatmen	Deckhand Engineer	$58.81	5B	1K		View
Kitsap	Inland Boatmen	Launch Operator	$58.89	5B	1K		View
Kitsap	Inland Boatmen	Mate	$57.31	5B	1K		View
Kitsap	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Cleaner Operator, Foamer Operator	$15.74		1		View
Kitsap	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Grout Truck Operator	$15.74		1		View
Kitsap	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Head Operator	$15.74		1		View
Kitsap	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Tv Truck Operator	$24.17		1		View
Kitsap	Insulation Applicators	Journey Level	$71.53	15J	4C		View
Kitsap	Ironworkers	Journeyman	$83.79	15K	11N		View
Kitsap	Laborers	Air, Gas Or Electric Vibrating Screed	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Airtrac Drill Operator	$58.56	15J	4V	8Y	View
Kitsap	Laborers	Ballast Regular Machine	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Batch Weighman	$48.14	15J	4V	8Y	View
Kitsap	Laborers	Brick Pavers	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Brush Cutter	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Brush Hog Feeder	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Burner	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Caisson Worker	$58.56	15J	4V	8Y	View

Kitsap	Laborers	Carpenter Tender	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Cement Dumper-paving	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Cement Finisher Tender	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Change House Or Dry Shack	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Chipping Gun (30 Lbs. And Over)	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Chipping Gun (Under 30 Lbs.)	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Choker Setter	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Chuck Tender	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Clary Power Spreader	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Clean-up Laborer	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Concrete Dumper/Chute Operator	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Concrete Form Stripper	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Concrete Placement Crew	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Concrete Saw Operator/Core Driller	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Crusher Feeder	$48.14	15J	4V	8Y	View
Kitsap	Laborers	Curing Laborer	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Demolition: Wrecking & Moving (Incl. Charred Material)	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Ditch Digger	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Diver	$58.56	15J	4V	8Y	View
Kitsap	Laborers	Drill Operator (Hydraulic, Diamond)	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Dry Stack Walls	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Dump Person	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Epoxy Technician	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Erosion Control Worker	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Faller & Bucker Chain Saw	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Fine Graders	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Firewatch	$48.14	15J	4V	8Y	View
Kitsap	Laborers	Form Setter	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Gabian Basket Builders	$56.80	15J	4V	8Y	View
Kitsap	Laborers	General Laborer	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Grade Checker & Transit Person	$59.85	15J	4V	8Y	View
Kitsap	Laborers	Grinders	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Grout Machine Tender	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Groutmen (Pressure) Including Post Tension Beams	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Guardrail Erector	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Hazardous Waste Worker (Level A)	$58.56	15J	4V	8Y	View
Kitsap	Laborers	Hazardous Waste Worker (Level B)	$57.84	15J	4V	8Y	View

Kitsap	Laborers	Hazardous Waste Worker (Level C)	$56.80	15J	4V	8Y	View
Kitsap	Laborers	High Scaler	$58.56	15J	4V	8Y	View
Kitsap	Laborers	Jackhammer	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Laserbeam Operator	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Maintenance Person	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Manhole Builder-Mudman	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Material Yard Person	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Mold Abatement Worker	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Motorman-Dinky Locomotive	$59.95	15J	4V	8Y	View
Kitsap	Laborers	nozzleman (concrete pump, green cutter when using combination of high pressure air & water on concrete & rock, sandblast, gunite, shotcrete, water blaster, vacuum blaster)	$59.85	15J	4V	8Y	View
Kitsap	Laborers	Pavement Breaker	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Pilot Car	$48.14	15J	4V	8Y	View
Kitsap	Laborers	Pipe Layer (Lead)	$59.85	15J	4V	8Y	View
Kitsap	Laborers	Pipe Layer/Tailor	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Pipe Pot Tender	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Pipe Reliner	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Pipe Wrapper	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Pot Tender	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Powderman	$58.56	15J	4V	8Y	View
Kitsap	Laborers	Powderman's Helper	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Power Jacks	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Railroad Spike Puller - Power	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Raker - Asphalt	$59.85	15J	4V	8Y	View
Kitsap	Laborers	Re-timberman	$58.56	15J	4V	8Y	View
Kitsap	Laborers	Remote Equipment Operator	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Rigger/Signal Person	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Rip Rap Person	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Rivet Buster	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Rodder	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Scaffold Erector	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Scale Person	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Sloper (Over 20")	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Sloper Sprayer	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Spreader (Concrete)	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Stake Hopper	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Stock Piler	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Swinging Stage/Boatswain Chair	$48.14	15J	4V	8Y	View
Kitsap	Laborers	Tamper & Similar Electric, Air & Gas Operated Tools	$57.84	15J	4V	8Y	View

Kitsap	Laborers	Tamper (Multiple & Self-propelled)	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Timber Person - Sewer (Lagger, Shorer & Cribber)	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Toolroom Person (at Jobsite)	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Topper	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Track Laborer	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Track Liner (Power)	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Traffic Control Laborer	$51.48	15J	4V	9C	View
Kitsap	Laborers	Traffic Control Supervisor	$54.55	15J	4V	9C	View
Kitsap	Laborers	Truck Spotter	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Tugger Operator	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Tunnel Work-Compressed Air Worker 0-30 psi	$158.87	15J	4V	9B	View
Kitsap	Laborers	Tunnel Work-Compressed Air Worker 30.01-44.00 psi	$163.90	15J	4V	9B	View
Kitsap	Laborers	Tunnel Work-Compressed Air Worker 44.01-54.00 psi	$167.58	15J	4V	9B	View
Kitsap	Laborers	Tunnel Work-Compressed Air Worker 54.01-60.00 psi	$173.28	15J	4V	9B	View
Kitsap	Laborers	Tunnel Work-Compressed Air Worker 60.01-64.00 psi	$175.40	15J	4V	9B	View
Kitsap	Laborers	Tunnel Work-Compressed Air Worker 64.01-68.00 psi	$180.50	15J	4V	9B	View
Kitsap	Laborers	Tunnel Work-Compressed Air Worker 68.01-70.00 psi	$182.40	15J	4V	9B	View
Kitsap	Laborers	Tunnel Work-Compressed Air Worker 70.01-72.00 psi	$184.40	15J	4V	9B	View
Kitsap	Laborers	Tunnel Work-Compressed Air Worker 72.01-74.00 psi	$186.40	15J	4V	9B	View
Kitsap	Laborers	Tunnel Work-Guage and Lock Tender	$59.95	15J	4V	8Y	View
Kitsap	Laborers	Tunnel Work-Miner	$59.95	15J	4V	8Y	View
Kitsap	Laborers	Vibrator	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Vinyl Seamer	$56.80	15J	4V	8Y	View
Kitsap	Laborers	Watchman	$43.76	15J	4V	8Y	View
Kitsap	Laborers	Welder	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Well Point Laborer	$57.84	15J	4V	8Y	View
Kitsap	Laborers	Window Washer/Cleaner	$43.76	15J	4V	8Y	View
Kitsap	Laborers - Underground Sewer & Water	General Laborer & Topman	$56.80	15J	4V	8Y	View
Kitsap	Laborers - Underground Sewer & Water	Pipe Layer	$57.84	15J	4V	8Y	View
Kitsap	Landscape Construction	Landscape Construction/Landscaping Or Planting Laborers	$43.76	15J	4V	8Y	View
Kitsap	Landscape Construction	Landscape Operator	$75.51	15J	11G	8X	View
Kitsap	Landscape Maintenance	Groundskeeper	$15.74		1		View
Kitsap	Lathers	Journey Level	$71.53	15J	4C		View

Kitsap	Marble Setters	Journey Level	$66.32	7E	1N		View
Kitsap	Metal Fabrication (In Shop)	Fitter	$26.96		1		View
Kitsap	Metal Fabrication (In Shop)	Laborer	$15.74		1		View
Kitsap	Metal Fabrication (In Shop)	Machine Operator	$15.74		1		View
Kitsap	Metal Fabrication (In Shop)	Welder	$15.74		1		View
Kitsap	Millwright	Journey Level	$73.08	15J	4C		View
Kitsap	Modular Buildings	Cabinet Assembly	$15.74		1		View
Kitsap	Modular Buildings	Electrician	$15.74		1		View
Kitsap	Modular Buildings	Equipment Maintenance	$15.74		1		View
Kitsap	Modular Buildings	Plumber	$15.74		1		View
Kitsap	Modular Buildings	Production Worker	$15.74		1		View
Kitsap	Modular Buildings	Tool Maintenance	$15.74		1		View
Kitsap	Modular Buildings	Utility Person	$15.74		1		View
Kitsap	Modular Buildings	Welder	$15.74		1		View
Kitsap	Painters	Journey Level	$49.46	6Z	11J		View
Kitsap	Pile Driver	Crew Tender	$77.16	15J	4C		View
Kitsap	Pile Driver	Journey Level	$71.98	15J	4C		View
Kitsap	Plasterers	Journey Level	$67.49	7Q	1R		View
Kitsap	Plasterers	Nozzleman	$71.49	7Q	1R		View
Kitsap	Playground & Park Equipment Installers	Journey Level	$15.74		1		View
Kitsap	Plumbers & Pipefitters	Journey Level	$84.72	5A	1G		View
Kitsap	Power Equipment Operators	Asphalt Plant Operators	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Assistant Engineer	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Barrier Machine (zipper)	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Batch Plant Operator: concrete	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Boat Operator	$76.79	7A	11H	8X	View
Kitsap	Power Equipment Operators	Bobcat	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Brokk - Remote Demolition Equipment	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Brooms	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Bump Cutter	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Cableways	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Chipper	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Compressor	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Concrete Finish Machine - Laser Screed	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Concrete Pump - Mounted Or Trailer High Pressure Line Pump, Pump High Pressure	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators	Concrete Pump: Truck Mount With Boom Attachment Over 42 M	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Concrete Pump: Truck Mount With Boom Attachment Up To 42m	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Conveyors	$75.51	15J	11G	8X	View

Kitsap	Power Equipment Operators	Cranes Friction: 200 tons and over	$79.13	7A	11H	8X	View
Kitsap	Power Equipment Operators	Cranes, A-frame: 10 tons and under	$72.22	7A	11H	8X	View
Kitsap	Power Equipment Operators	Cranes: 100 tons through 199 tons, or 150' of boom (including jib with attachments)	$77.56	7A	11H	8X	View
Kitsap	Power Equipment Operators	Cranes: 20 tons through 44 tons with attachments	$76.11	7A	11H	8X	View
Kitsap	Power Equipment Operators	Cranes: 200 tons- 299 tons, or 250' of boom including jib with attachments	$78.36	7A	11H	8X	View
Kitsap	Power Equipment Operators	Cranes: 300 tons and over or 300' of boom including jib with attachments	$79.13	7A	11H	8X	View
Kitsap	Power Equipment Operators	Cranes: 45 tons through 99 tons, under 150' of boom(including jib with attachments)	$76.79	7A	11H	8X	View
Kitsap	Power Equipment Operators	Cranes: Friction cranes through 199 tons	$78.36	7A	11H	8X	View
Kitsap	Power Equipment Operators	Cranes: through 19 tons with attachments, a-frame over 10 tons	$75.53	7A	11H	8X	View
Kitsap	Power Equipment Operators	Crusher	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Deck Engineer/Deck Winches (power)	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Derricks, On Building Work	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Dozers D-9 & Under	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators	Drill Oilers: Auger Type, Truck Or Crane Mount	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators	Drilling Machine	$77.54	15J	11G	8X	View
Kitsap	Power Equipment Operators	Elevator and man-lift: permanent and shaft type	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Finishing Machine, Bidwell And Gamaco & Similar Equipment	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Forklift: 3000 lbs and over with attachments	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators	Forklifts: under 3000 lbs. with attachments	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Grade Engineer: Using Blue Prints, Cut Sheets, Etc	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Gradechecker/Stakeman	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Guardrail Punch	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Hard Tail End Dump Articulating Off- Road Equipment 45 Yards. & Over	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Hard Tail End Dump Articulating Off-road Equipment Under 45 Yards	$76.09	15J	11G	8X	View

Kitsap	Power Equipment Operators	Horizontal/Directional Drill Locator	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators	Horizontal/Directional Drill Operator	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Hydralifts/Boom Trucks Over 10 Tons	$75.53	7A	11H	8X	View
Kitsap	Power Equipment Operators	Hydralifts/boom trucks: 10 tons and under	$72.22	7A	11H	8X	View
Kitsap	Power Equipment Operators	Leverman	$78.33	15J	11G	8X	View
Kitsap	Power Equipment Operators	Loader, Overhead, 6 Yards. But Not Including 8 Yards	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Loaders, Overhead Under 6 Yards	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Loaders, Plant Feed	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Loaders: Elevating Type Belt	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators	Locomotives, All	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Material Transfer Device	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Mechanics: All (Leadmen - $0.50 per hour over mechanic)	$77.54	15J	11G	8X	View
Kitsap	Power Equipment Operators	Motor Patrol Graders	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Mucking Machine, Mole, Tunnel Drill, Boring, Road Header And/or Shield	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Oil Distributors, Blower Distribution & Mulch Seeding Operator	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Outside Hoists (Elevators and Manlifts), Air Tuggers, Strato	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators	Overhead, bridge type Crane: 20 tons through 44 tons	$76.11	7A	11H	8X	View
Kitsap	Power Equipment Operators	Overhead, bridge type: 100 tons and over	$77.56	7A	11H	8X	View
Kitsap	Power Equipment Operators	Overhead, bridge type: 45 tons through 99 tons	$76.79	7A	11H	8X	View
Kitsap	Power Equipment Operators	Pavement Breaker	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Pile Driver (other Than Crane Mount)	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Plant Oiler - Asphalt, Crusher	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators	Posthole Digger, Mechanical	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Power Plant	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Pumps - Water	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Quad 9, Hd 41, D10 And Over	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Quick Tower: no cab, under 100 feet in height base to boom	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Remote Control Operator On Rubber Tired Earth Moving Equipment	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Rigger and Bellman	$72.22	7A	11H	8X	View

Kitsap	Power Equipment Operators	Rigger/Signal Person, Bellman(Certified)	$75.53	7A	11H	8X	View
Kitsap	Power Equipment Operators	Rollagon	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Roller, Other Than Plant Mix	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Roller, Plant Mix Or Multi-lift Materials	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators	Roto-mill, Roto-grinder	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Saws - Concrete	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators	Scraper, Self Propelled Under 45 Yards	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Scrapers - Concrete & Carry All	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators	Scrapers, Self-propelled: 45 Yards And Over	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Service Engineers: Equipment	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators	Shotcrete/Gunite Equipment	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Shovel, Excavator, Backhoe, Tractors Under 15 Metric Tons	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators	Shovel, Excavator, Backhoe: Over 30 Metric Tons To 50 Metric Tons	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Shovel, Excavator, Backhoes, Tractors: 15 To 30 Metric Tons	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Shovel, Excavator, Backhoes: Over 50 Metric Tons To 90 Metric Tons	$77.54	15J	11G	8X	View
Kitsap	Power Equipment Operators	Shovel, Excavator, Backhoes: Over 90 Metric Tons	$78.33	15J	11G	8X	View
Kitsap	Power Equipment Operators	Slipform Pavers	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Spreader, Topsider & Screedman	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Subgrader Trimmer	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Tower Bucket Elevators	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators	Tower Crane: over 175' through 250' in height, base to boom	$78.36	7A	11H	8X	View
Kitsap	Power Equipment Operators	Tower crane: up to 175' in height base to boom	$77.56	7A	11H	8X	View
Kitsap	Power Equipment Operators	Tower Cranes: over 250' in height from base to boom	$79.13	7A	11H	8X	View
Kitsap	Power Equipment Operators	Transporters, All Track Or Truck Type	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Trenching Machines	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators	Truck Crane Oiler/Driver: 100 tons and over	$76.11	7A	11H	8X	View
Kitsap	Power Equipment Operators	Truck crane oiler/driver: under 100 tons	$75.53	7A	11H	8X	View
Kitsap	Power Equipment Operators	Truck Mount Portable Conveyor	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators	Vac Truck (Vactor Guzzler,	$76.09	15J	11G	8X	View

		Hydro Excavator)					
Kitsap	Power Equipment Operators	Welder	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators	Wheel Tractors, Farmall Type	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators	Yo Yo Pay Dozer	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Asphalt Plant Operators	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Assistant Engineer	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Barrier Machine (zipper)	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Batch Plant Operator, Concrete	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Boat Operator	$76.79	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Bobcat	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Brokk - Remote Demolition Equipment	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Brooms	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Bump Cutter	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Cableways	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Chipper	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Compressor	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Concrete Finish Machine - Laser Screed	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Concrete Pump - Mounted Or Trailer High Pressure Line Pump, Pump High Pressure	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Concrete Pump: Truck Mount With Boom Attachment Over 42 M	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Concrete Pump: Truck Mount With Boom Attachment Up To 42m	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Conveyors	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Cranes Friction: 200 tons and over	$79.13	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Cranes, A-frame: 10 tons and under	$72.22	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Cranes: 100 tons through 199 tons, or 150' of boom (including jib with attachments)	$77.56	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Cranes: 20 tons through 44 tons with attachments	$76.11	7A	11H	8X	View

Kitsap	Power Equipment Operators-Underground Sewer & Water	Cranes: 20 tons through 44 tons with attachments	$76.11	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Cranes: 200 tons- 299 tons, or 250' of boom including jib with attachments	$78.36	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Cranes: 300 tons and over or 300' of boom including jib with attachments	$79.13	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Cranes: 45 tons through 99 tons, under 150' of boom(including jib with attachments)	$76.79	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Cranes: Friction cranes through 199 tons	$78.36	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Cranes: through 19 tons with attachments, a-frame over 10 tons	$75.53	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Crusher	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Deck Engineer/Deck Winches (power)	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Derricks, On Building Work	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Dozers D-9 & Under	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Drill Oilers: Auger Type, Truck Or Crane Mount	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Drilling Machine	$77.54	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Elevator and man-lift: permanent and shaft type	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Finishing Machine, Bidwell And Gamaco & Similar Equipment	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Forklift: 3000 lbs and over with attachments	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Forklifts: under 3000 lbs. with attachments	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Grade Engineer: Using Blue Prints, Cut Sheets, Etc	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Gradechecker/Stakeman	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Guardrail Punch	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Hard Tail End Dump Articulating Off- Road Equipment 45 Yards. & Over	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Hard Tail End Dump Articulating Off-road Equipment Under 45 Yards	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Horizontal/Directional Drill Locator	$75.51	15J	11G	8X	View

Kitsap	Power Equipment Operators-Underground Sewer & Water	Horizontal/Directional Drill Operator	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Hydralifts/boom trucks: 10 tons and under	$72.22	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Hydralifts/boom trucks: over 10 tons	$75.53	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Leverman	$78.33	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Loader, Overhead, 6 Yards. But Not Including 8 Yards	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Loaders, Overhead Under 6 Yards	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Loaders, Plant Feed	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Loaders: Elevating Type Belt	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Locomotives, All	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Material Transfer Device	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Mechanics: All (Leadmen - $0.50 per hour over mechanic)	$77.54	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Motor Patrol Graders	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Mucking Machine, Mole, Tunnel Drill, Boring, Road Header And/or Shield	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Oil Distributors, Blower Distribution & Mulch Seeding Operator	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Outside Hoists (Elevators and Manlifts), Air Tuggers, Strato	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Overhead, bridge type Crane: 20 tons through 44 tons	$76.11	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Overhead, bridge type: 100 tons and over	$77.56	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Overhead, bridge type: 45 tons through 99 tons	$76.79	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Pavement Breaker	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Pile Driver (other Than Crane Mount)	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Plant Oiler - Asphalt, Crusher	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Posthole Digger, Mechanical	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Power Plant	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Pumps - Water	$72.20	15J	11G	8X	View

Kitsap	Power Equipment Operators-Underground Sewer & Water	Quad 9, Hd 41, D10 And Over	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Quick Tower: no cab, under 100 feet in height base to boom	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Remote Control Operator On Rubber Tired Earth Moving Equipment	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Rigger and Bellman	$72.22	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Rigger/Signal Person, Bellman(Certified)	$75.53	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Rollagon	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Roller, Other Than Plant Mix	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Roller, Plant Mix Or Multi-lift Materials	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Roto-mill, Roto-grinder	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Saws - Concrete	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Scraper, Self Propelled Under 45 Yards	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Scrapers - Concrete & Carry All	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Scrapers, Self-propelled: 45 Yards And Over	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Shotcrete/Gunite Equipment	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoe, Tractors Under 15 Metric Tons	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoe: Over 30 Metric Tons To 50 Metric Tons	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoes, Tractors: 15 To 30 Metric Tons	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoes: Over 50 Metric Tons To 90 Metric Tons	$77.54	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoes: Over 90 Metric Tons	$78.33	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Slipform Pavers	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Spreader, Topsider & Screedman	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Subgrader Trimmer	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Tower Bucket Elevators	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Tower Crane: over 175' through 250' in height, base	$78.36	7A	11H	8X	View

		to boom					
Kitsap	Power Equipment Operators-Underground Sewer & Water	Tower crane: up to 175' in height base to boom	$77.56	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Tower Cranes: over 250' in height from base to boom	$79.13	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Transporters, All Track Or Truck Type	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Trenching Machines	$75.51	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Truck Crane Oiler/Driver: 100 tons and over	$76.11	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Truck Crane Oiler/Driver: 100 tons and over	$76.11	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Truck crane oiler/driver: under 100 tons	$75.53	7A	11H	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Truck Mount Portable Conveyor	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Vac Truck (Vactor Guzzler, Hydro Excavator)	$76.09	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Welder	$76.77	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Wheel Tractors, Farmall Type	$72.20	15J	11G	8X	View
Kitsap	Power Equipment Operators-Underground Sewer & Water	Yo Yo Pay Dozer	$76.09	15J	11G	8X	View
Kitsap	Power Line Clearance Tree Trimmers	Journey Level In Charge	$57.22	5A	4A		View
Kitsap	Power Line Clearance Tree Trimmers	Spray Person	$54.32	5A	4A		View
Kitsap	Power Line Clearance Tree Trimmers	Tree Equipment Operator	$57.22	5A	4A		View
Kitsap	Power Line Clearance Tree Trimmers	Tree Trimmer	$51.18	5A	4A		View
Kitsap	Power Line Clearance Tree Trimmers	Tree Trimmer Groundperson	$38.99	5A	4A		View
Kitsap	Refrigeration & Air Conditioning Mechanics	Journey Level	$85.71	5A	1G		View
Kitsap	Residential Brick Mason	Journey Level	$22.01		1		View
Kitsap	Residential Carpenters	Journey Level	$26.25		1		View
Kitsap	Residential Cement Masons	Journey Level	$39.88		1		View
Kitsap	Residential Drywall Applicators	Journey Level	$49.92	15J	4C		View
Kitsap	Residential Drywall Tapers	Journey Level	$25.84		1		View
Kitsap	Residential Electricians	Journey Level	$44.11		1		View
Kitsap	Residential Glaziers	Journey Level	$51.80	7L	1H		View
Kitsap	Residential Insulation Applicators	Journey Level	$18.03		1		View
Kitsap	Residential Laborers	Journey Level	$15.74		1		View
Kitsap	Residential Marble Setters	Journey Level	$22.01		1		View
Kitsap	Residential Painters	Journey Level	$20.85		1		View

Kitsap	Residential Plumbers & Pipefitters	Journey Level	$35.92		1		View
Kitsap	Residential Refrigeration & Air Conditioning Mechanics	Journey Level	$40.21		1		View
Kitsap	Residential Sheet Metal Workers	Journey Level	$32.91		1		View
Kitsap	Residential Soft Floor Layers	Journey Level	$22.03		1		View
Kitsap	Residential Sprinkler Fitters (Fire Protection)	Journey Level	$31.53		1		View
Kitsap	Residential Stone Masons	Journey Level	$66.32	7E	1N		View
Kitsap	Residential Terrazzo Workers	Journey Level	$15.74		1		View
Kitsap	Residential Terrazzo/Tile Finishers	Journey Level	$39.09		1		View
Kitsap	Residential Tile Setters	Journey Level	$35.40		1		View
Kitsap	Roofers	Journey Level	$60.95	5A	3H		View
Kitsap	Roofers	Using Irritable Bituminous Materials	$63.95	5A	3H		View
Kitsap	Sheet Metal Workers	Journey Level (Field or Shop)	$94.11	7F	1E		View
Kitsap	Shipbuilding & Ship Repair	New Construction Boilermaker	$50.35	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	New Construction Carpenter	$50.95	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	New Construction Crane Operator	$41.83	7V	1		View
Kitsap	Shipbuilding & Ship Repair	New Construction Electrician	$50.42	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	New Construction Heat & Frost Insulator	$84.84	15H	11C		View
Kitsap	Shipbuilding & Ship Repair	New Construction Laborer	$50.95	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	New Construction Machinist	$50.95	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	New Construction Operating Engineer	$41.83	7V	1		View
Kitsap	Shipbuilding & Ship Repair	New Construction Painter	$50.95	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	New Construction Pipefitter	$50.95	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	New Construction Rigger	$50.35	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	New Construction Sheet Metal	$50.35	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	New Construction Shipwright	$50.95	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	New Construction Warehouse/Teamster	$41.83	7V	1		View
Kitsap	Shipbuilding & Ship Repair	New Construction Welder / Burner	$50.35	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	Ship Repair Boilermaker	$50.35	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	Ship Repair Carpenter	$50.95	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	Ship Repair Crane Operator	$45.06	7Y	4K		View
Kitsap	Shipbuilding & Ship Repair	Ship Repair Electrician	$50.42	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	Ship Repair Heat & Frost Insulator	$84.84	15H	11C		View
Kitsap	Shipbuilding & Ship Repair	Ship Repair Laborer	$50.95	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	Ship Repair Machinist	$50.95	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	Ship Repair Operating Engineer	$45.06	7Y	4K		View

Kitsap	Shipbuilding & Ship Repair	Ship Repair Painter	$50.95	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	Ship Repair Pipefitter	$50.95	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	Ship Repair Rigger	$50.35	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	Ship Repair Sheet Metal	$50.35	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	Ship Repair Shipwright	$50.95	7X	4J		View
Kitsap	Shipbuilding & Ship Repair	Ship Repair Warehouse / Teamster	$45.06	7Y	4K		View
Kitsap	Sign Makers & Installers (Electrical)	Journey Level	$55.78	0	1		View
Kitsap	Sign Makers & Installers (Non-Electrical)	Journey Level	$35.73	0	1		View
Kitsap	Soft Floor Layers	Journey Level	$62.39	15J	4C		View
Kitsap	Solar Controls For Windows	Journey Level	$15.74		1		View
Kitsap	Sprinkler Fitters (Fire Protection)	Journey Level	$92.49	5C	1X		View
Kitsap	Stage Rigging Mechanics (Non Structural)	Journey Level	$15.74		1		View
Kitsap	Stone Masons	Journey Level	$66.32	7E	1N		View
Kitsap	Street And Parking Lot Sweeper Workers	Journey Level	$16.00		1		View
Kitsap	Surveyors	Assistant Construction Site Surveyor	$75.53	7A	11H	8X	View
Kitsap	Surveyors	Chainman	$72.22	7A	11H	8X	View
Kitsap	Surveyors	Construction Site Surveyor	$76.79	7A	11H	8X	View
Kitsap	Surveyors	Drone Operator (when used in conjunction with survey work only)	$72.22	7A	11H	8X	View
Kitsap	Surveyors	Ground Penetrating Radar Operator	$72.22	7A	11H	8X	View
Kitsap	Telecommunication Technicians	Journey Level	$62.13	7E	1E		View
Kitsap	Telephone Line Construction - Outside	Cable Splicer	$39.15	5A	2B		View
Kitsap	Telephone Line Construction - Outside	Hole Digger/Ground Person	$26.29	5A	2B		View
Kitsap	Telephone Line Construction - Outside	Telephone Equipment Operator (Light)	$32.72	5A	2B		View
Kitsap	Telephone Line Construction - Outside	Telephone Lineperson	$37.00	5A	2B		View
Kitsap	Terrazzo Workers	Journey Level	$60.36	7E	1N		View
Kitsap	Tile Setters	Journey Level	$60.36	7E	1N		View
Kitsap	Tile, Marble & Terrazzo Finishers	Finisher	$51.19	7E	1N		View
Kitsap	Traffic Control Stripers	Journey Level	$51.90	7A	1K		View
Kitsap	Truck Drivers	Asphalt Mix Over 16 Yards	$71.70	15J	11M	8L	View
Kitsap	Truck Drivers	Asphalt Mix To 16 Yards	$70.86	15J	11M	8L	View
Kitsap	Truck Drivers	Dump Truck	$70.86	15J	11M	8L	View
Kitsap	Truck Drivers	Dump Truck & Trailer	$71.70	15J	11M	8L	View
Kitsap	Truck Drivers	Other Trucks	$71.70	15J	11M	8L	View

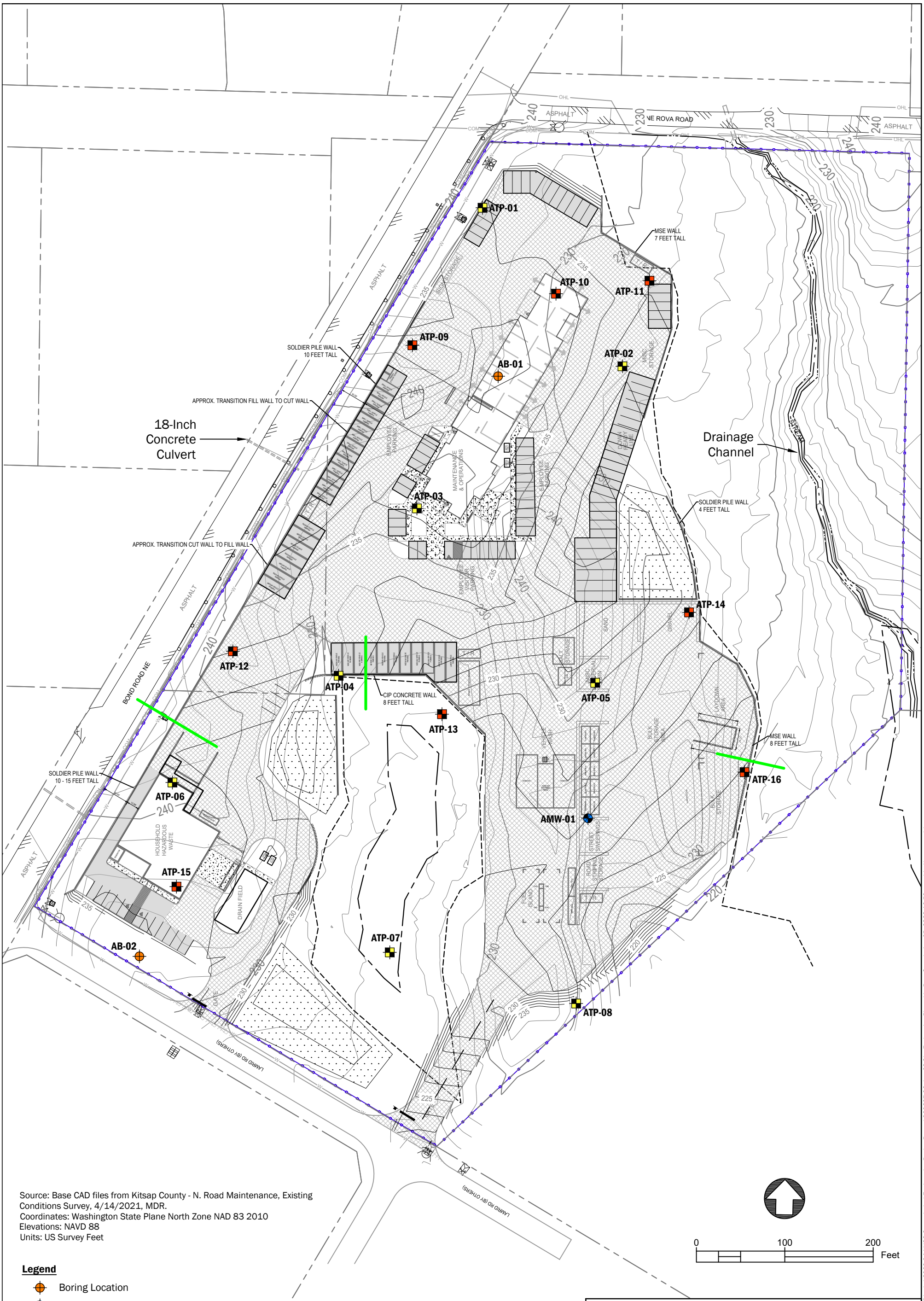
Kitsap	Truck Drivers - Ready Mix	Transit Mix	$71.70	15J	11M	8L	View
Kitsap	Well Drillers & Irrigation Pump Installers	Irrigation Pump Installer	$15.74		1		View
Kitsap	Well Drillers & Irrigation Pump Installers	Oiler	$15.74		1		View
Kitsap	Well Drillers & Irrigation Pump Installers	Well Driller	$15.74		1		View

This page intentionally left blank

Appendix B

North Kitsap Service Center, Geotechnical Engineering Report
Exploration Logs, Aspect Consulting, November 2022

This page intentionally left blank



Source: Base CAD files from Kitsap County - N. Road Maintenance, Existing Conditions Survey, 4/14/2021, MDR.
Coordinates: Washington State Plane North Zone NAD 83 2010
Elevations: NAVD 88
Units: US Survey Feet

Legend

- Boring Location
- Monitoring Well Location
- Test Pit Location
- Section Location for Wall Global Stability Analysis
- Wetland Area
- Wetland Buffer
- Kitsap County Property Parcel
- 2 Foot Elevation Contour

Survey Base Map Legend

- GAS LINE MARKER SIGN
- WATER VALVE
- FIRE HYDRANT
- FIRE DEPARTMENT CONNECTION
- WATER VAULT
- WATER METER
- COMMUNICATION RISER
- UTILITY POLE
- SIGN
- LINE CONTINUES
- OHL — OVER HEAD UTILITY LINE
- W — WATER LINE
- COM — COMMUNICATION LINE
- CULVERT PIPE

Site Exploration Plan

Geotechnical Engineering Design Report
Kitsap County Public Works
North Kitsap Service Center
Kitsap County, Washington

Aspect Consulting	Aug-2022	BY: AJH/SCC	FIGURE NO. 3
	PROJECT NO. 200297	REVISED BY: -	

CAD Path: Q:\Kitsap County\200297 North Road District\2022-04 NKSC Geotechnical Engineering Design Report\200297-02.dwg 02 Site Exploration Plan || Date Saved: Aug 05, 2022 10:52am || User: cvanslyke

This page intentionally left blank

Coarse-Grained Soils - More than 50%[1] Retained on No. 200 Sieve	Gravels - More than 50%[1] of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines	GW	Well-graded GRAVEL Well-graded GRAVEL WITH SAND
			GP	Poorly-graded GRAVEL Poorly-graded GRAVEL WITH SAND
		≥15% Fines	GM	SILTY GRAVEL SILTY GRAVEL WITH SAND
			GC	CLAYEY GRAVEL CLAYEY GRAVEL WITH SAND
	Sands - 50%[1] or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines	SW	Well-graded SAND Well-graded SAND WITH GRAVEL
			SP	Poorly-graded SAND Poorly-graded SAND WITH GRAVEL
		≥15% Fines	SM	SILTY SAND SILTY SAND WITH GRAVEL
			SC	CLAYEY SAND CLAYEY SAND WITH GRAVEL
Fine-Grained Soils - 50%[1] or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50%		ML	SILT SANDY or GRAVELLY SILT SILT WITH SAND SILT WITH GRAVEL
			CL	LEAN CLAY SANDY or GRAVELLY LEAN CLAY LEAN CLAY WITH SAND LEAN CLAY WITH GRAVEL
			OL	ORGANIC SILT SANDY or GRAVELLY ORGANIC SILT ORGANIC SILT WITH SAND ORGANIC SILT WITH GRAVEL
	Silts and Clays Liquid Limit 50% or More		MH	ELASTIC SILT SANDY or GRAVELLY ELASTIC SILT ELASTIC SILT WITH SAND ELASTIC SILT WITH GRAVEL
			CH	FAT CLAY SANDY or GRAVELLY FAT CLAY FAT CLAY WITH SAND FAT CLAY WITH GRAVEL
			OH	ORGANIC CLAY SANDY or GRAVELLY ORGANIC CLAY ORGANIC CLAY WITH SAND ORGANIC CLAY WITH GRAVEL
Highly Organic Soils			PT	PEAT and other mostly organic soils

"WITH SILT" or "WITH CLAY" means 5 to 15% silt and clay, denoted by a "-" in the group name; e.g., SP-SM • "SILTY" or "CLAYEY" means >15% silt and clay • "WITH SAND" or "WITH GRAVEL" means 15 to 30% sand and gravel. • "SANDY" or "GRAVELLY" means >30% sand and gravel. • "Well-graded" means approximately equal amounts of fine to coarse grain sizes • "Poorly graded" means unequal amounts of grain sizes • Group names separated by "/" means soil contains layers of the two soil types; e.g., SM/ML.

Soils were described and identified in the field in general accordance with the methods described in ASTM D2488. Where indicated in the log, soils were classified using ASTM D2487 or other laboratory tests as appropriate. Refer to the report accompanying these exploration logs for details.

1. Estimated or measured percentage by dry weight
2. (SPT) Standard Penetration Test (ASTM D1586)
3. Determined by SPT, DCPT (ASTM STP399) or other field methods. See report text for details.

GEOTECHNICAL LAB TESTS

MC	=	Natural Moisture Content
PS	=	Particle Size Distribution
FC	=	Fines Content (% < 0.075 mm)
GH	=	Hydrometer Test
AL	=	Atterberg Limits
C	=	Consolidation Test
Str	=	Strength Test
OC	=	Organic Content (% Loss by Ignition)
Comp	=	Proctor Test
K	=	Hydraulic Conductivity Test
SG	=	Specific Gravity Test

CHEMICAL LAB TESTS

Organic Chemicals

BTEX	=	Benzene, Toluene, Ethylbenzene, Xylenes
TPH-Dx	=	Diesel and Oil-Range Petroleum Hydrocarbons
TPH-G	=	Gasoline-Range Petroleum Hydrocarbons
VOCs	=	Volatile Organic Compounds
SVOCs	=	Semi-Volatile Organic Compounds
PAHs	=	Polycyclic Aromatic Hydrocarbon Compounds
PCBs	=	Polychlorinated Biphenyls

Metals

RCRA8	=	As, Ba, Cd, Cr, Pb, Hg, Se, Ag, (d = dissolved, t = total)
MTCA5	=	As, Cd, Cr, Hg, Pb (d = dissolved, t = total)
PP-13	=	Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn (d=dissolved, t=total)

FIELD TESTS

PID	=	Photoionization Detector
Sheen	=	Oil Sheen Test
SPT[2]	=	Standard Penetration Test
NSPT	=	Non-Standard Penetration Test
DCPT	=	Dynamic Cone Penetration Test

COMPONENT DEFINITIONS

Descriptive Term		*Size Range and Sieve Number*
Boulders	=	Larger than 12 inches
Cobbles	=	3 inches to 12 inches
Coarse Gravel	=	3 inches to 3/4 inches
Fine Gravel	=	3/4 inches to No. 4 (4.75 mm)
Coarse Sand	=	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	=	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	=	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	=	Smaller than No. 200 (0.075 mm)

ESTIMATED[1] PERCENTAGE

% by Weight		*Modifier*	*% by Weight*		*Modifier*
<1	=	Subtrace	15 to 25	=	Little
1 to <5	=	Trace	30 to 45	=	Some
5 to 10	=	Few	>50	=	Mostly

MOISTURE CONTENT

Dry	=	Absence of moisture, dusty, dry to the touch
Slightly Moist	=	Perceptible moisture
Moist	=	Damp but no visible water
Very Moist	=	Water visible but not free draining
Wet	=	Visible free water, usually from below water table

RELATIVE DENSITY

Non-Cohesive or Coarse-Grained Soils

Density[3]		*SPT*[2] *Blows/Foot*	*Penetration with 1/2" Diameter Rod*
Very Loose	=	0 to 4	≥ 2'
Loose	=	5 to 10	1' to 2'
Medium Dense	=	11 to 30	3" to 1'
Dense	=	31 to 50	1" to 3"
Very Dense	=	> 50	< 1"

CONSISTENCY

Cohesive or Fine-Grained Soils

Consistency[3]		*SPT*[2] *Blows/Foot*	*Manual Test*
Very Soft	=	0 to 1	Penetrated >1" easily by thumb. Extrudes between thumb & fingers.
Soft	=	2 to 4	Penetrated 1/4" to 1" easily by thumb. Easily molded.
Medium Stiff	=	5 to 8	Penetrated >1/4" with effort by thumb. Molded with strong pressure.
Stiff	=	9 to 15	Indented ~1/4" with effort by thumb.
Very Stiff	=	16 to 30	Indented easily by thumbnail.
Hard	=	> 30	Indented with difficulty by thumbnail.

GEOLOGIC CONTACTS

Observed and Distinct — Observed and Gradual — Inferred

Aspect CONSULTING

Exploration Log Key

Al Path: Q:_ACAD Standards\FIELD REFERENCE\MASTERS\Exploration Log Key-2018.ai // user: jinman // last saved: 12/31/2018

This page intentionally left blank

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site North		*Coordinates (SPN NAD83 ft)* E:1205300 N:288140	*Exploration Number* **AB-01**
Contractor Holocene	*Equipment* Sonic Geoprobe 8140LC	*Sampling Method* Autohammer; 140 lb hammer; 30" drop	*Ground Surface Elev. (NAVD88)* 230'	
Operator Corey Thrash	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 3/22/2021	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* 18.3' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
		Backfilled with 3/8" bentonite chips and capped with topsoil.						**TOPSOIL** SANDY SILT WITH GRAVEL (ML); loose, moist, dark brown; non-plastic; fine to coarse sand; fine to coarse gravel; abundant organics.	
								WEATHERED VASHON TILL SILTY SAND WITH GRAVEL (SM); very dense, moist, light brown; fine to coarse sand; fine gravel; few roots.	
								Becomes gray brown without organics at 4 ft bgs.	
5	225		S1	● ▲	39 30 30	MC, GH FC=42.4%			5
								Iron oxide staining from 9.5 to 10.5 ft bgs.	
10	220	Low recovery due to coarse gravel in shoe.	S2	● ▲	26 36 40	PS FC=31.4%			10
								Becomes with 3" to 6" cobbles at 12 ft bgs.	
15	215	▽ 3/22/2021 10:26am	S3	● ▲	9 19 28	FC FC=20.4%			15
								Becomes wet at 16 ft bgs.	
		▽ 3/22/2021 10:18am						**VASHON TILL** SILTY SAND WITH GRAVEL AND COBBLES (SM); very dense, moist, gray brown; fine to coarse sand; fine to coarse gravel; 3" to 4" cobbles; irregularly scattered silt (ML) lenses.	
20	210		S4	▲	41 50/4"				20
25	205		S5	● ▲	39 50/4"	MC			25

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 5" ID
- ◪ Split Barrel 2" X 1.375" (SPT)

Plastic Limit ⊢⊣ Liquid Limit

Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: JRG
Approved by: AJH

Exploration Log AB-01
Sheet 1 of 2

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - AB_AMW.GPJ July 19, 2021

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site North		*Coordinates (SPN NAD83 ft)* E:1205300 N:288140	*Exploration Number* **AB-01**
Contractor Holocene	*Equipment* Sonic Geoprobe 8140LC	*Sampling Method* Autohammer; 140 lb hammer; 30" drop	*Ground Surface Elev. (NAVD88)* 230'	
Operator Corey Thrash	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 3/22/2021	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* 18.3' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%) ● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
			S6		12 10 30	FC FC=17%		**VASHON TILL** SILTY SAND WITH GRAVEL AND COBBLES (SM); very dense, moist, gray brown; fine to coarse sand; fine to coarse gravel; 3" to 4" cobbles; irregularly scattered silt (ML) lenses. (continued) Sand becomes coarse at 30 ft bgs.	
35	195		S7		17 38 50/5"			Trace iron oxide staining at 38 ft bgs.	35
40	190	Low continuous core recovery due to seepage.	S8		15 26 37				40
45	185		S9		12 30 36				45
50	180		S10		24 50/5"	PS FC=9.6%		Bottom of exploration at 50.9 ft. bgs. Note: Boring terminated per plan. Gravel content in the labs is typically less than 15% but may not be representative of the unit due to sampling limitations (2" sampler). These samples are limited for representing larger particle sizes.	50
55	175								55

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 5" ID
- ◪ Split Barrel 2" X 1.375" (SPT)

Plastic Limit ⊢—⊣ Liquid Limit

Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: JRG
Approved by: AJH

Exploration Log AB-01
Sheet 2 of 2

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - AB_AMW.GPJ July 19, 2021

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site South		*Coordinates (SPN NAD83 ft)* E:1204900 N:287480	*Exploration Number* **AB-02**
Contractor Holocene	*Equipment* Sonic Geoprobe 8140LC	*Sampling Method* Autohammer; 140 lb hammer; 30" drop	*Ground Surface Elev. (NAVD88)* 232.1'	
Operator Corey Thrash	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 3/23/2021	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* 18.25' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%) ● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	232	Backfilled with 3/8" bentonite chips and capped with topsoil.						**TOPSOIL** SANDY SILT WITH GRAVEL (ML); loose, moist, dark brown; non-plastic; fine to coarse sand; fine to coarse gravel; abundant organics.	0
								WEATHERED VASHON TILL SILTY SAND WITH GRAVEL AND COBBLES (SM); very dense, moist, light brown; fine to coarse sand; fine to coarse gravel; 3" to 4" cobbles; trace organics. Iron oxide staining from 3.0 to 24.0 ft bgs at irregular intervals Becomes gray brown without organics at 4 ft bgs. Blows/foot overstate the soil density due to the presence of gravel and cobbles.	
5	230		S1	▲	24 26 30				5
	225								
10	220		S2	● ▲	6 6 9	PS FC=33.6%		SILTY SAND (SM); medium dense, moist, gray brown; fine to medium sand; few fine to coarse gravel; trace 3" to 4" cobbles.	10
15	215	▽ 3/23/2021 1:12pm ▽ 3/23/2021 1:08pm	S3	▲	10 10 12			SILTY SAND WITH GRAVEL AND COBBLES (SM); medium dense, wet, gray brown; coarse sand; fine to coarse gravel; 3" to 4" cobbles. Becomes moist; sand becomes fine to medium at 19 ft bgs.	15
20	210		S4	▲	6 10 20	FC FC=32.4%			20
								VASHON TILL SILTY SAND WITH GRAVEL AND COBBLES (SM); very dense, moist, gray brown; fine to medium sand; fine to coarse gravel; 3" to 4" cobbles.	
25	205		S5	▲	50/6"				25

Legend

Sample Type
- Continuous core 5" ID
- Split Barrel 2" X 1.375" (SPT)

Plastic Limit ⊢⊣ Liquid Limit

Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: JRG
Approved by: AJH

Exploration Log AB-02
Sheet 1 of 2

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - AB_AMW.GPJ July 19, 2021

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site South		*Coordinates (SPN NAD83 ft)* E:1204900 N:287480	*Exploration Number* **AB-02**
Contractor Holocene	*Equipment* Sonic Geoprobe 8140LC	*Sampling Method* Autohammer; 140 lb hammer; 30" drop	*Ground Surface Elev. (NAVD88)* 232.1'	
Operator Corey Thrash	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 3/23/2021	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* 18.25' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
			S6		50/3"	MC		**VASHON TILL** SILTY SAND WITH GRAVEL AND COBBLES (SM); very dense, moist, gray brown; fine to medium sand; fine to coarse gravel; 3" to 4" cobbles. (continued)	
	200							SILTY GRAVEL WITH SAND AND COBBLES (GM); very dense, wet, dark gray; coarse sand; fine to coarse gravel; 3" to 4" cobbles.	
35			S7		50/5"			SILTY SAND WITH GRAVEL (SM); very dense, moist, gray brown; fine to medium sand; fine to coarse gravel.	35
	195								
40			S8		9 24 50/4"	PS FC=33.7%		Becomes with 3" cobbles.	40
	190							Sand becomes coarse.	
45			S9		40 50/2"				45
	185							Sand becomes fine to medium.	
50			S10		22 50/3"	MC			50
	180							Bottom of exploration at 50.75 ft. bgs. Note: Boring terminated per plan. Gravel content in the labs is typically less than 15% but may not be representative of the unit due to sampling limitations (2" sampler). These samples are limited for representing larger particle sizes.	
55									55
	175								

Legend

Sample Type
- Continuous core 5" ID
- Split Barrel 2" X 1.375" (SPT)

Plastic Limit ⊢⊣ Liquid Limit

Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: JRG
Approved by: AJH

Exploration Log AB-02
Sheet 2 of 2

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - AB_AMW.GPJ July 19, 2021

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site East		*Coordinates (SPN NAD83 ft)* E:1205400 N:287640	*Exploration Number* **AMW-01**
Contractor Holocene	*Equipment* Sonic Geoprobe 8140LC	*Sampling Method* Autohammer; 140 lb hammer; 30" drop	*Ground Surface Elev. (NAVD88)* 226.4'	
Operator Corey Thrash	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 3/22/2021	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* 18.5' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
		Flush monument set in concrete.						**TOPSOIL** SILTY SAND WITH GRAVEL (SM); loose, moist, dark brown; fine to coarse sand; fine to coarse gravel; abundant organics.	
	225	Locked expansion plug. 0 to 15 ft. bgs, 4" Schedule 40 PVC casing. 3 to 13 ft. bgs, bentonite chips.						**WEATHERED VASHON TILL** SILTY SAND WITH GRAVEL AND COBBLES (SM); very dense, moist, light brown; fine to medium sand; fine to coarse gravel; 3" cobbles; few organics. Becomes gray brown without organics.	
5			S1	● ▲	21 32 37	MC, GH FC=54.7%		Trace iron oxide staining from 5.0 to 6.5 ft bgs.	5
	220								
10			S2	▲	14 19 20			Trace iron oxide staining at 11 ft bgs.	10
	215	13 to 25 ft. bgs, silica sand pack.						SILTY GRAVEL WITH SAND AND COBBLES (GM); dense, moist, dark gray; coarse sand; medium to coarse gravel; 3" cobbles.	
15		15 to 25 ft. bgs, 4" slotted Schedule 40 PVC casing.	S3	▲	18 30 32	FC FC=64.5%		SILT WITH GRAVEL (ML); hard, moist, gray brown; low plasticity; fine sand; medium gravel.	15
	210	▽ 3/22/2021						SILTY SAND WITH GRAVEL (SM); very dense, moist, gray brown with iron oxide staining at irregular intervals.; fine to coarse sand; medium gravel.	
20			S4	▲	20 30 43			Becomes wet.	20
	205								
		Low continuous core recovery due to seepage.							
25		25 to 28 ft. bgs, bentonite chips.	S5	▲	7 14 26	FC FC=19.7%			25
	200	28 to 50.25 ft. bgs, collapsed native fill.						**VASHON TILL** SILTY SAND WITH GRAVEL (SM); very dense, moist, gray brown; fine to medium sand; fine to coarse gravel.	

Plastic Limit ⊢—⊣ Liquid Limit

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ▮▯ Continuous core 5" ID
- ◪ Split Barrel 2" X 1.375" (SPT)

Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: JRG
Approved by: AJH

Exploration Log AMW-01
Sheet 1 of 2

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - AB_AMW.GPJ July 19, 2021

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site East		*Coordinates (SPN NAD83 ft)* E:1205400 N:287640	*Exploration Number* **AMW-01**
Contractor Holocene	*Equipment* Sonic Geoprobe 8140LC	*Sampling Method* Autohammer; 140 lb hammer; 30" drop	*Ground Surface Elev. (NAVD88)* 226.4'	
Operator Corey Thrash	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 3/22/2021	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* 18.5' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
			S6		18 30 50/5"	PS FC=40.2%		**VASHON TILL** SILTY SAND WITH GRAVEL (SM); very dense, moist, gray brown; fine to medium sand; fine to coarse gravel. (continued) Becomes with 3" to 4" cobbles.	
35	195		S7		43 50/4"	MC			35
	190								
40			S8		50/3"				40
	185								
45			S9		50/3"	MC			45
	180								
50			S10		50/3"			Bottom of exploration at 50.25 ft. bgs. Note: Boring terminated per plan. Gravel content in the labs is typically less than 15% but may not be representative of the unit due to sampling limitations (2" sampler). These samples are limited for representing larger particle sizes.	50
	175								
55									55
	170								

Legend

Sample Type
- No Soil Sample Recovery
- Continuous core 5" ID
- Split Barrel 2" X 1.375" (SPT)

Plastic Limit ⊢⊣ Liquid Limit

Water Level
- Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: JRG
Approved by: AJH

Exploration Log AMW-01
Sheet 2 of 2

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - AB_AMW.GPJ July 19, 2021

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site North		*Coordinates (SPN NAD83 ft)* E:1205300 N:288330 (est)	*Exploration Number* **ATP-01**
Contractor High Meadows Excavating	*Equipment* Hitachi ZAXIS 85USB	*Sampling Method* Grab	*Ground Surface Elev.* 233.8' (est)	
Operator David	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 3/19/2021	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 6' (Seep)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	233	Backfilled with the excavated material tamped into place.						**TOPSOIL** SANDY SILT (ML); very soft, moist, dark brown; non-plastic; fine to coarse sand; abundant organics.	0
1						DCPT =4,5,8		**WEATHERED VASHON TILL** SILTY SAND (SM); dense, moist, light brown; fine to medium sand; few fine gravel; dense roots.	1
2	232								2
3	231					DCPT =12,12/1"		SILTY SAND WITH GRAVEL (SM); very dense, moist, gray brown with iron oxide staining; coarse sand; fine to coarse gravel. Becomes gray brown without iron oxide staining.	3
4	230		S1						4
5	229								5
6	228	▽ 3/19/2021 Perched							6
7	227							3" Silt (ML) lense, very stiff, moist, gray with iron oxide staining; medium plasticity.	7
8	226		S2	●		PS FC=12.9%		SILTY SAND (SM); very dense, moist, dark gray; fine to medium sand; few fine to coarse gravel.	8
9	225								9
10	224								10
11	223							SAND WITH SILT (SP-SM); very dense, moist, gray; fine sand.	11
12	222		S3						12
13	221							Bottom of exploration at 12.5 ft. bgs. Note: Test pit terminated per plan.	13
14	220								14
	219								

Legend

Sample Type: Grab sample

Plastic Limit ⊢⊣ Liquid Limit

Water Level: ▽ Water Level (Seepage)

See Exploration Log Key for explanation of symbols

Logged by: JRG
Approved by: AJH

Exploration Log ATP-01
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ July 19, 2021

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site Northeast		*Coordinates (SPN NAD83 ft)* E:1205400 N:288150 (est)	*Exploration Number* **ATP-02**
Contractor High Meadows Excavating	*Equipment* Hitachi ZAXIS 85USB	*Sampling Method* Grab	*Ground Surface Elev.* 227.3' (est)	
Operator David	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 3/19/2021	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 4' (Seep)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	227	Backfilled with the excavated material tamped into place.						**TOPSOIL** SANDY SILT (ML); very soft, moist, dark brown; non-plastic; fine to coarse sand; abundant organics.	0
1	226					DCPT =4,4,5		**WEATHERED VASHON TILL** SILTY SAND (SM); dense, moist, light brown; fine to medium sand; few fine gravel; some organics.	1
2	225								2
3	224					DCPT =5,9,12/1"		SILTY SAND (SM); very dense, moist, gray brown; fine sand; trace fine gravel.	3
4	223	3/19/2021 Perched							4
5	222		S1					SILT (ML); very stiff, moist, gray brown; non-plastic; trace fine gravel.	5
6	221								6
7	220								7
8	219		S2	●		MC, GH, AL FC=99.4%		SILT (ML); medium stiff; light brown; low to medium plasticity; trace gravel; trace 3" cobbles.	8
9	218								9
10	217								10
11	216							SILTY SAND WITH GRAVEL AND COBBLES (SM); very dense, moist, gray brown; fine to medium sand; fine to coarse gravel; 3" cobbles.	11
12	215								12
13	214							Bottom of exploration at 12.5 ft. bgs. Note: Test pit terminated per plan.	13
14	213								14

Legend

Sample Type: Grab sample

Plastic Limit ⊢⊣ Liquid Limit

Water Level: Water Level (Seepage)

See Exploration Log Key for explanation of symbols

Logged by: JRG
Approved by: AJH

Exploration Log ATP-02

Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ July 19, 2021

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site Center		*Coordinates (SPN NAD83 ft)* E:1205200 N:287990 (est)	*Exploration Number* **ATP-03**
Contractor High Meadows Excavating	*Equipment* Hitachi ZAXIS 85USB	*Sampling Method* Grab	*Ground Surface Elev.* 228' (est)	
Operator David	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 3/19/2021	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 8.5' (Seep)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	228							**TOPSOIL** SANDY SILT (ML); very soft, moist, dark brown; non-plastic; fine to coarse sand; abundant organics.	0
1	227	Backfilled with the excavated material tamped into place.				DCPT =8,12/1"		**WEATHERED VASHON TILL** SAND WITH SILT (SP-SM); dense, moist, light brown with iron oxide staining; fine to medium sand; few fine gravel; some organics.	1
2	226		S1	●		MC			2
3	225					DCPT =12/1"			3
4	224							SILT (ML); very stiff, moist, gray with iron oxide staining; medium plasticity.	4
5	223	Bucket sample.	S2	●		MC, MP FC=20.3%		SILTY SAND WITH GRAVEL AND COBBLES (SM); very dense, moist, gray brown; fine to coarse sand; fine to coarse gravel; 3" to 5" cobbles.	5
6	222								6
7	221								7
8	220	▽ 3/19/2021							8
9	219								9
10	218		S3					Becomes with 3" to 12" cobbles.	10
11	217								11
12	216							Bottom of exploration at 12 ft. bgs. Note: Test pit terminated per plan.	12
13	215								13
14	214								14

Legend

Sample Type: ☑ Grab sample

Plastic Limit ⊢⊣ Liquid Limit

Water Level: ▽ Water Level (Seepage)

See Exploration Log Key for explanation of symbols

Logged by: JRG
Approved by: AJH

Exploration Log ATP-03
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ July 19, 2021

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site Center		*Coordinates (SPN NAD83 ft)* E:1205100 N:287800 (est)	*Exploration Number* **ATP-04**
Contractor High Meadows Excavating	*Equipment* Hitachi ZAXIS 85USB	*Sampling Method* Grab	*Ground Surface Elev.* 226.4' (est)	
Operator David	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 3/19/2021	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 3.5' (Seep)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	226	Backfilled with the excavated material tamped into place.						**TOPSOIL** SANDY SILT (ML); very soft, moist, dark brown; non-plastic; fine to coarse sand; abundent organics.	0
1	225							**WEATHERED VASHON TILL** SILTY SAND (SM); dense, moist, light brown; fine to medium sand; few fine gravel; some roots.	1
2	224		S1	●		DCPT =2,12/0.5" MC			2
3	223	▽ 3/19/2021 Perched						SANDY SILT (ML); very stiff, moist, light gray with iron oxide staining; medium plasticity; fine sand.	3
4	222		S2			FC FC=78.2%			4
5	221							SILTY SAND WITH GRAVEL (SM); very dense, moist, gray brown; fine sand; fine gravel.	5
6	220								6
7	219							3" Silt (ML) lense, very stiff, moist, gray with iron oxide staining; medium plasticity. Becomes wet.	7
8	218							Sand becomes fine to coarse.	8
9	217								9
10	216								10
11	215								11
12	214		S3					Bottom of exploration at 12.5 ft. bgs. Note: Test pit terminated per plan.	12
13	213								13
14	212								14

Legend

Sample Type: Grab sample

Plastic Limit ⊢⟶⊣ Liquid Limit

Water Level: ▽ Water Level (Seepage)

See Exploration Log Key for explanation of symbols

Logged by: JRG
Approved by: AJH

Exploration Log ATP-04

Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ July 19, 2021

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site East		*Coordinates (SPN NAD83 ft)* E:1205400 N:287790 (est)	*Exploration Number* **ATP-05**
Contractor High Meadows Excavating	*Equipment* Hitachi ZAXIS 85USB	*Sampling Method* Grab	*Ground Surface Elev.* 237.9' (est)	
Operator David	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 3/19/2021	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	237	Backfilled with the excavated material tamped into place.						**TOPSOIL** SANDY SILT (ML); very soft, moist, dark brown; non-plastic; fine to coarse sand; abundant organics.	0
								WEATHERED VASHON TILL SILTY SAND WITH GRAVEL (SM); medium dense, moist, light brown; coarse sand; fine to coarse gravel; some roots.	
2	236					DCPT =3,6,10			2
3	235					DCPT =3,5,9			3
4	234		S1					SILTY SAND WITH GRAVEL AND COBBLES (SM); very dense, moist, gray brown; fine to coarse sand; fine to coarse gravel; 3" to 5" cobble.	4
5	233								5
6	232								6
7	231	Bucket sample.	S2	● I		MC, MP LL=23%			7
8	230	Operator reports hard digging.							8
9	229								9
10	228								10
11	227								11
12	226		S3	●		MC		Bottom of exploration at 12 ft. bgs. Note: Test pit terminated per plan.	12
13	225								13
14	224								14
	223								

Legend

Sample Type: Grab sample

Plastic Limit ⊢⊣ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: JRG
Approved by: AJH

Exploration Log ATP-05

Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ July 19, 2021

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site Southwest		*Coordinates (SPN NAD83 ft)* E:1204900 N:287680 (est)	*Exploration Number* **ATP-06**
Contractor High Meadows Excavating	*Equipment* Hitachi ZAXIS 85USB	*Sampling Method* Grab	*Ground Surface Elev.* 240.9' (est)	
Operator David	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 3/19/2021	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
1	240	Backfilled with the excavated material tamped into place.				DCPT =2,2,3		**TOPSOIL** SANDY SILT (ML); very soft, moist, dark brown; non-plastic; fine to coarse sand; abundant organics; some roots.	1
2	239							**WEATHERED VASHON TILL** SILTY SAND WITH GRAVEL (SM); medium dense, moist, light brown; fine to coarse sand; fine to coarse gravel; some roots and organics.	2
3	238								3
4	237							SILTY SAND WITH GRAVEL AND COBBLES (SM); very dense, moist, gray brown; fine to coarse sand; fine to coarse gravel; 3" to 5" cobbles	4
5	236								5
6	235		S1			FC FC=13.4%			6
7	234							Becomes 3" to 8" cobbles.	7
8	233								8
9	232								9
10	231								10
11	230		S2						11
12	229							Bottom of exploration at 12 ft. bgs. Note: Test pit terminated per plan.	12
13	228								13
14	227								14
	226								

Legend

Sample Type: Grab sample

Plastic Limit ⊢⊣ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: JRG
Approved by: AJH

Exploration Log ATP-06
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ July 19, 2021

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site South		*Coordinates (SPN NAD83 ft)* E:1205200 N:287490 (est)	*Exploration Number* **ATP-07**
Contractor High Meadows Excavating	*Equipment* Hitachi ZAXIS 85USB	*Sampling Method* Grab	*Ground Surface Elev.* 222.5' (est)	
Operator David	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 3/19/2021	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 2' (Seep)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	222	Backfilled with the excavated material tamped into place.				DCPT =6,5,8		**TOPSOIL** SANDY SILT (ML); very soft, moist, dark brown; non-plastic; fine to coarse sand; abundant organics. Becomes wet.	0
1	221	3/19/2021 Perched						**WEATHERED TILL** SILTY SAND (SM); medium, wet, light brown; fine to medium sand; trace fine gravel.	1
2	220					DCPT =8,7,8			2
3	219								3
4	218		S1	●		MC, GH FC=40.1%			4
5	217							SILTY SAND WITH GRAVEL AND COBBLES (SM); dense, moist, gray brown; fine to coarse sand; fine to coarse gravel; 3" to 5" cobble.	5
6	216								6
7	215								7
8	214								8
9	213		S2						9
10	212								10
11	211							Bottom of exploration at 11.5 ft. bgs. Note: Test pit terminated per plan.	11
12	210								12
13	209								13
14	208								14

Legend

Sample Type: Grab sample

Plastic Limit ⊢⊣ Liquid Limit

Water Level: Water Level (Seepage)

See Exploration Log Key for explanation of symbols

Logged by: JRG
Approved by: AJH

Exploration Log ATP-07
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ July 19, 2021

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site Southeast		*Coordinates (SPN NAD83 ft)* E:1205400 N:287430 (est)	*Exploration Number* **ATP-08**
Contractor High Meadows Excavating	*Equipment* Hitachi ZAXIS 85USB	*Sampling Method* Grab	*Ground Surface Elev.* 229.8' (est)	
Operator David	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 3/19/2021	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	229	Backfilled with the excavated material tamped into place.						**TOPSOIL** SANDY SILT (ML); very soft, moist, dark brown; non-plastic; fine to coarse sand; abundant organics.	0
1						DCPT =5,5,7		**WEATHERED VASHON TILL** SILTY SAND WITH GRAVEL (SM); dense, moist, light brown; fine to coarse sand; fine gravel; dense roots.	1
2	228		S1						2
3	227					DCPT =7,12,12/0.5"			3
4	226							SILTY SAND WITH GRAVEL AND COBBLES (SM); very dense, moist, gray brown; fine to coarse sand; fine to coarse gravel; 3" cobbles.	4
5	225	Operator reports hard digging.							5
6	224								6
7	223								7
8	222								8
9	221	Bucket sample.	S2	●		MC, GH FC=24.7%			9
10	220							Becomes few gravel.	10
11	219								11
12	218		S3	●		PS FC=22.5%			12
13	217							Bottom of exploration at 12.5 ft. bgs. Note: Test pit terminated per plan.	13
14	216								14
	215								

Legend

Sample Type: Grab sample

Plastic Limit ⊢⊣ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: JRG
Approved by: AJH

Exploration Log ATP-08

Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ July 19, 2021

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site North		*Coordinates (Lat,Lon WGS84)* 47.7763, -122.6038 (est)	*Exploration Number* **ATP-09**
Contractor High Meadows Excavating	*Equipment* Excavator or Backhoe	*Sampling Method* Grab	*Ground Surface Elev. (NAVD88)* 242.5' (est)	
Operator Andrew	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 5/26/2022	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
	242							**TOPSOIL** TOPSOIL; organic topsoil.	
1		Test pit backfilled with excavated soils.						**WEATHERED VASHON TILL** SILTY SAND WITH GRAVEL (SM); medium dense to very dense, slightly moist, light brown to gray; fine to coarse sand; fine to coarse, subrounded gravel; 4 inch cobbles.	1
2	241							Becomes gray.	2
3	240								3
4	239								4
5	238								5
6	237								6
7	236							Becomes very dense with diamict texture; hard digging by excavator.	7
8	235								8
9	234		S-1	●		FC=28.3%			9
10	233								10
11	232							Bottom of exploration at 10.5 ft. bgs. Note: Test pit terminated per plan.	11
12	231								12
13	230								13
14	229								14
	228								

Legend

Sample Type: Grab sample

Plastic Limit ⊢⊣ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: KDS
Approved by: AJH

Exploration Log ATP-09

Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ October 7, 2022

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site North		*Coordinates (Lat,Lon WGS84)* 47.7763, -122.6029 (est)	*Exploration Number* **ATP-10**
Contractor High Meadows Excavating	*Equipment* Excavator or Backhoe	*Sampling Method* Grab	*Ground Surface Elev. (NAVD88)* 231' (est)	
Operator Andrew	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 5/26/2022	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
								TOPSOIL TOPSOIL; organic topsoil.	
1	230	Test pit backfilled with excavated soils.						**WEATHERED VASHON TILL** SAND WITH SILT, GRAVEL, AND COBBLES (SP-SM); medium dense, moist, red brown; fine sand; fine, subrounded gravel; 4 inch cobbles.	1
2	229							SILTY SAND (SM); dense, very moist, gray; fine sand.	2
3	228								3
4	227								4
5	226							Iron-oxide staining noted.	5
6	225								6
7	224		S-1					SILT (ML); very stiff, very moist, gray; low plasticity.	7
8	223								8
9	222		S-2	●		PS FC=99%			9
10	221								10
11	220							Bottom of exploration at 11 ft. bgs. Note: Test pit terminated per plan.	11
12	219								12
13	218								13
14	217								14

Legend

Sample Type: Grab sample

Plastic Limit ⊢⊣ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: KDS
Approved by: AJH

Exploration Log ATP-10

Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ October 7, 2022

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site North		*Coordinates (Lat,Lon WGS84)* 47.7764, -122.6025 (est)	*Exploration Number* **ATP-11**
Contractor High Meadows Excavating	*Equipment* Excavator or Backhoe	*Sampling Method* Grab	*Ground Surface Elev. (NAVD88)* 229' (est)	
Operator Andrew	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 5/26/2022	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* 3.5' (Seep)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
								TOPSOIL TOPSOIL; organic topsoil.	
1	228	Test pit backfilled with excavated soils.						**WEATHERED VASHON TILL** SAND WITH SILT (SP-SM); medium dense, moist, red brown; fine to medium sand; few fine, subrounded gravel.	1
2	227								2
3	226	5/26/2022	S-1	●		PS FC=8.2%		Becomes gray and very moist.	3
4	225							SANDY SILT (ML); stiff, very moist, gray; non-plastic.	4
5	224								5
6	223		S-2	●		AL			6
7	222								7
8	221								8
9	220								9
10	219							Bottom of exploration at 10 ft. bgs. Note: Test pit terminated per plan.	10
11	218								11
12	217								12
13	216								13
14	215								14

Legend

Sample Type: Grab sample

Plastic Limit ⊢⟶⊣ Liquid Limit

Water Level: Water Level (Seepage)

See Exploration Log Key for explanation of symbols

Logged by: KDS
Approved by: AJH

Exploration Log ATP-11
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ October 7, 2022

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site Southwest		*Coordinates (Lat,Lon WGS84)* 47.7752, -122.6040 (est)	*Exploration Number* **ATP-12**
Contractor High Meadows Excavating	*Equipment* Excavator or Backhoe	*Sampling Method* Grab	*Ground Surface Elev. (NAVD88)* 242.5' (est)	
Operator Andrew	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 5/26/2022	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	242							**TOPSOIL** TOPSOIL; organic topsoil.	0
1	241	Test pit backfilled with excavated soils.	S-1					**WEATHERED VASHON TILL** SILTY SAND WITH GRAVEL AND COBBLES (SM); medium dense, moist, red brown; fine to medium sand; fine, subrounded gravel; 5 inch cobbles.	1
2	240							SILTY SAND (SM); dense to very dense, moist, gray; fine sand; fine to coarse, trace subrounded to subangular gravel; 5 inch cobbles.	2
3	239								3
4	238								4
5	237								5
6	236		S-2	●		PS FC=42.2%			6
7	235								7
8	234								8
9	233							Bottom of exploration at 9 ft. bgs. Note: Test pit terminated per plan.	9
10	232								10
11	231								11
12	230								12
13	229								13
14	228								14

Legend

Sample Type: Grab sample

Plastic Limit ⊢⊣ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: KDS
Approved by: AJH

Exploration Log ATP-12
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ October 7, 2022

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site South		*Coordinates (Lat,Lon WGS84)* 47.7749, -122.6035 (est)	*Exploration Number* **ATP-13**
Contractor High Meadows Excavating	*Equipment* Excavator or Backhoe	*Sampling Method* Grab	*Ground Surface Elev. (NAVD88)* 230' (est)	
Operator Andrew	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 5/26/2022	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* 1.5' (Seep)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
								TOPSOIL TOPSOIL; organic topsoil.	
1	229	Test pit backfilled with excavated soils. 5/25/2022						**WEATHERED VASHON TILL** SILT (ML); soft to medium stiff, very moist, gray and brown yellow; low plasticity.	1
2	228							Significant mottling and caving of test pit walls noted.	2
3	227		S-1	●		FC=94.6%		Thin laminations/bedding layers noted.	3
4	226							SILTY SAND (SM); medium dense, very moist to wet, brown and gray; fine to medium sand.	4
5	225								5
6	224								6
7	223								7
8	222		S-2	●		PS FC=32.5%		Becomes very dense.	8
9	221								9
10	220							Bottom of exploration at 10 ft. bgs. Note: Test pit terminated per plan.	10
11	219								11
12	218								12
13	217								13
14	216								14

Legend

Sample Type: Grab sample

Plastic Limit ⊢⊣ Liquid Limit

Water Level: Water Level (Seepage)

See Exploration Log Key for explanation of symbols

Logged by: KDS
Approved by: AJH

Exploration Log ATP-13
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ October 7, 2022

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site East		*Coordinates (Lat,Lon WGS84)* 47.7757, -122.6024 (est)	*Exploration Number* **ATP-14**
Contractor High Meadows Excavating	*Equipment* Excavator or Backhoe	*Sampling Method* Grab	*Ground Surface Elev. (NAVD88)* 234.5' (est)	
Operator Andrew	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 5/26/2022	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	234							**TOPSOIL** TOPSOIL; Organic Topsoil	0
1	233	Test pit backfilled with excavated soils.						**WEATHERED VASHON TILL** SILTY SAND (SM); medium dense, moist, brown; fine to coarse sand; little organics.	1
2	232								2
3	231							Becomes gray and dense.	3
4	230								4
5	229								5
6	228								6
7	227		S-1					Becomes very dense. Large boulder, greater than 3 feet in diameter.	7
8	226								8
9	225							Bottom of exploration at 9 ft. bgs. Note: Test pit terminated per plan.	9
10	224								10
11	223								11
12	222								12
13	221								13
14	220								14

Legend

Sample Type: Grab sample

Plastic Limit ⊢⊣ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: KDS
Approved by: AJH

Exploration Log ATP-14
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ October 7, 2022

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site South		*Coordinates (Lat,Lon WGS84)* 47.7745, -122.6047 (est)	*Exploration Number* **ATP-15**
Contractor High Meadows Excavating	*Equipment* Excavator or Backhoe	*Sampling Method* Grab	*Ground Surface Elev. (NAVD88)* 247' (est)	
Operator Andrew	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 5/26/2022	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
								TOPSOIL TOPSOIL; organic topsoil.	
1	246	Test pit backfilled with excavated soils.						**WEATHERED VASHON TILL** SILTY SAND WITH GRAVEL AND COBBLES (SM); medium dense to very dense, moist, light brown; fine to coarse sand; fine, subrounded gravel; 4 inch cobbles.	1
2	245							Becomes gray.	2
3	244							Large tree root in test pit wall.	3
4	243							SILTY SAND WITH GRAVEL (SM); very dense, moist, light gray; fine to medium sand; fine subrounded gravel.	4
5	242							Soil has diamict texture.	5
6	241		S-1						6
7	240								7
8	239								8
9	238							Bottom of exploration at 8.5 ft. bgs. Note: Excavator refusal at 8.5 ft. bgs.	9
10	237								10
11	236								11
12	235								12
13	234								13
14	233								14

Legend

Sample Type: Grab sample

Plastic Limit ⊢⊣ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: KDS
Approved by: AJH

Exploration Log ATP-15
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ October 7, 2022

Aspect CONSULTING	North Kitsap Service Center - 200297		Geotechnical Exploration Log	
	Project Address & Site Specific Location Parcel No. 062602-2-064-2007, Kitsap County, Site East		*Coordinates (Lat,Lon WGS84)* 47.7750, -122.6019 (est)	*Exploration Number* **ATP-16**
Contractor High Meadows Excavating	*Equipment* Excavator or Backhoe	*Sampling Method* Grab	*Ground Surface Elev. (NAVD88)* 224' (est)	
Operator Andrew	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 5/26/2022	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* 6' (Seep)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0								**TOPSOIL** TOPSOIL; organic topsoil.	0
1	223	Test pit backfilled with excavated soils.						**WEATHERED VASHON TILL?** SAND WITH SILT AND GRAVEL (SP-SM); medium dense, moist, brown; fine to medium sand; fine to medium sand; fine, subrounded gravel; some organics.	1
2	222								2
3	221								3
4	220							SAND (SP); medium dense to dense, very moist, gray; fine to medium sand.	4
5	219								5
6	218	5/26/2022	S-1	●		PS FC=11.3%		SILTY SAND (SM); dense to very dense, very moist, grayfine to coarse sand; trace fine to coarse, subrounded gravel.	6
7	217								7
8	216								8
9	215								9
10	214		S-2					Bottom of exploration at 10 ft. bgs. Note: Test pit terminated per plan.	10
11	213								11
12	212								12
13	211								13
14	210								14

Legend

Sample Type: Grab sample

Plastic Limit ⊢⊣ Liquid Limit

Water Level: Water Level (Seepage)

See Exploration Log Key for explanation of symbols

Logged by: KDS
Approved by: AJH

Exploration Log ATP-16
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\KITSAP NORTH MAINTENANCE FACILITY - 200297 - ATP.GPJ October 7, 2022

Appendix C

Contracting Agency-Furnished Permits

- Kitsap Health District Health Officer Decision for Onsite Sewage System
- Washington State Department of Transportation, General Permit
- Kitsap County Department of Community Development, Site Development Activity Permit (SDAP) 22-03979 Plan Acceptance
- Kitsap County Department of Community Development, Notice of Administrative Decision for Administrative Conditional Use Permit (ACUP)
- Washington State Department of Ecology, Coverage under the Construction Stormwater General Permit

This page intentionally left blank

- Kitsap Health District Health Officer Decision for Onsite Sewage System

This page intentionally left blank

KITSAP PUBLIC
HEALTH DISTRICT

345 6th Street, Suite 300
Bremerton, WA 98337
360-728-2235

HEALTH OFFICER DECISION

Application Type: Building Site Application - ReDesign

Memo #: 123027
Tax ID #: 062602-2-064-2007
RP ACCT ID: 2646388
Expiration: 12/15/2025

Property Information

23026 BOND RD NE
Poulsbo WA 98370

Contractor of Record

Contractor Name: Allied Design Inc.
Contractor Phone #: (360) 620-7054

Applicant

OTAK INC
11241 Willow Rd #200
Redmond WA 98052

062602-2-064-2007

Waivers

Waiver Type	Memo #	Notes
Waiver Class B	1298141	18" of vertical separation for pressure distribution.

Health Officer Decision for Onsite Sewage System

Approved (See Conditions Below)	Name of Inspector:	Date:
	Christine Bronder	*02/02/2023*

Stake out the drainfield prior to installation.

System is approved for residential strength waste only.

Health Officer Decision for Water Supply

Approved (See Conditions Below)	Name of Inspector:	Date:
	Christine Bronder	*04/19/2023*

OTAK INC

Final Decision: Approved

This page intentionally left blank

KITSAP PUBLIC HEALTH DISTRICT

RECEIVED
JAN 30 2023
KITSAP PUBLIC HEALTH DISTRICT

345 6th Street, Suite 300
Bremerton, WA 98337
360-728-2235

BUILDING SITE APPLICATION

FOR WATER SUPPLY & ONSITE SEWAGE SYSTEM

Submittal Date	Memo Number	Review Fee	S.S.I.
JAN 30 2023	123077	$145	CRB

BUILDING SITE INFORMATION

Building Site Address – Street, City, Zip Code:
23026 Bond Dr; Poulsbo 98370

Assessor Tax Account Number:
062602-2-064-2007

Property Size:
681,278

Lot Number:

APPLICANT INFORMATION

First & Last Name
OTAK Inc

Phone Number:
(425) 739-4219

E-Mail:
jeff.massie@otak.com

Mailing Address – Street, City, State, Zip Code:
11241 Willow Rd # 200; Redmond, WA 98052

APPLICATION GENERAL PROPOSAL

Application Type:
- ☐ New
- ☐ Repair (no building permit needed)
- ☐ Modification (building permit needed)
- ☐ Building Clearance with Compliance

Application Use Type:
- ☑ Residential
- ☐ Multi-Family
- ☐ Community
- ☑ Commercial

Application Water Type:
- ☑ Public Water
- ☐ Private Water (residential only)

☑ *This is a Redesign (describe what is being changed) OR a Building Clearance with Compliance (describe proposal)*

Increased design flow from 240 gpd to 360 gpd

APPLICANT/AGENT & DESIGNER ACKNOWLEDGEMENT

I certify that (1) the information contained in this application is true and accurate to the best of my knowledge; (2) the application represents my intended use of this property; and (3) any related building permits for which I apply for will be consistent with the plans and specifications contained in this application.

I acknowledge and understand that I, along with my contractors, are responsible for adhering to the conditions of approval of this application and are responsible for conforming to applicable Kitsap County Board of Health ordinances and Washington State Department of Health regulations for onsite sewage systems and water supply.

I acknowledge and understand that the design, location, and construction of my onsite sewage system and/or well is/are critical and of a sensitive nature, and I agree to protect these areas as required by the regulations.

I understand that once this application is submitted and/or approved, any changes to, or variations from, the information or conditions related to this plan may require a revised application submittal and/or could result in the revocation, denial, or suspension of this application or a related building permit and that this application will fully expire within 3 (three) years and 30 (thirty) days from the original date of application submittal.

I understand that I have the right to appeal the Health Officer's decision concerning this application pursuant to the regulations, and that approval of this application does not guarantee that a building permit will be issued.

Designer/Engineer Stamp

ONSITE WASTEWATER TREATMENT SYSTEM
STATE OF WASHINGTON
5100333
THOMAS E. WEAVER
LICENSED DESIGNER
EXPIRES 01/25/2025

Designer/Engineer Contact Phone Number:
(360) 620-7054

Applicant/Agent Signature

Date
01/30/2023

Designer/Engineer E-Mail Address:
tweaver1431@gmail.com

Intake Notes – Health District Use Only

DRINKING WATER & ONSITE SEWAGE SYSTEM SPECIFICATION SHEET

Assessor Tax Account Number: 062602-2-064-2007

A. DRINKING WATER SUPPLY INFORMATION

☐ Proposed
☑ Existing

☑ Public
☐ Private
☐ Individual
☐ 2-Party

System Name: Vinland

System ID: 91923K

ASSESSOR TAX ACCOUNT NUMBERS FOR PROPERTIES SERVED BY WELL

Water Connection 1 (Parcel with Well)	Water Connection 2 (Parcel connected to Well)

B. SOIL EVALUATION PROFILES

Soil Evaluation Date: 02/25/2022

SOIL LOG NUMBERS MUST CORRELATE WITH SITE PLAN – INDICATE TOTAL EXCAVATED DEPTH, SOIL TYPES, WATER TABLE LEVEL & DEPTH OF RESTRICTIVE LAYER

SOIL LOG #1	SOIL LOG #2	SOIL LOG #3	SOIL LOG #4
Downslope Side Measurements	*Downslope Side Measurements*	*Downslope Side Measurements*	*Downslope Side Measurements*
0-26" Sand Loam 26" Semi Compact	0-24" Sand Loam 24" Semi Compact	Same as SL#1	

RECEIVED
JAN 30 2023
KITSAP PUBLIC HEALTH DISTRICT

C. DAILY FLOW – TANKAGE – TREATMENT

DESIGNED MAX SEWAGE FLOW
360 Gallons Per Day

PROPOSED RESIDENTIAL BEDROOMS
NA Maximum Bedrooms

PROPOSED TREATMENT LEVEL
TL E

TRASH/SEPTIC/PUMP TANKS

Type	Size (gal)	QTY
☐ Trash Tank		
☑ Septic Tank	1,000	2
☑ Pump Tank	1,000	2
☐ Other		

ADVANCED TREATMENT INFORMATION

☐ Proprietary Advanced Treatment
Manufacturer:
Model:
☐ Non-Proprietary Advanced Treatment
Device Type:

D. DISPERSAL COMPONENT CONSTRUCTION

DISPERSAL COMPONENT SIZING

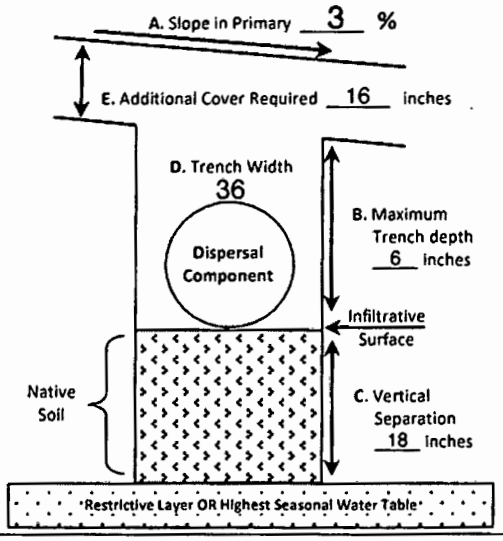
Hydraulic Loading Rate of Dispersal Area: .6

Minimum Dispersal Area (Sq. Ft.) In Primary: 600

Minimum Linear Feet or Dimensions: 200

DISTRIBUTION METHOD

☐ Gravity Distribution
☑ Pressure Distribution
☐ Drip Irrigation
☐ Other: _____



TRENCH CONSTRUCTION PROFILE

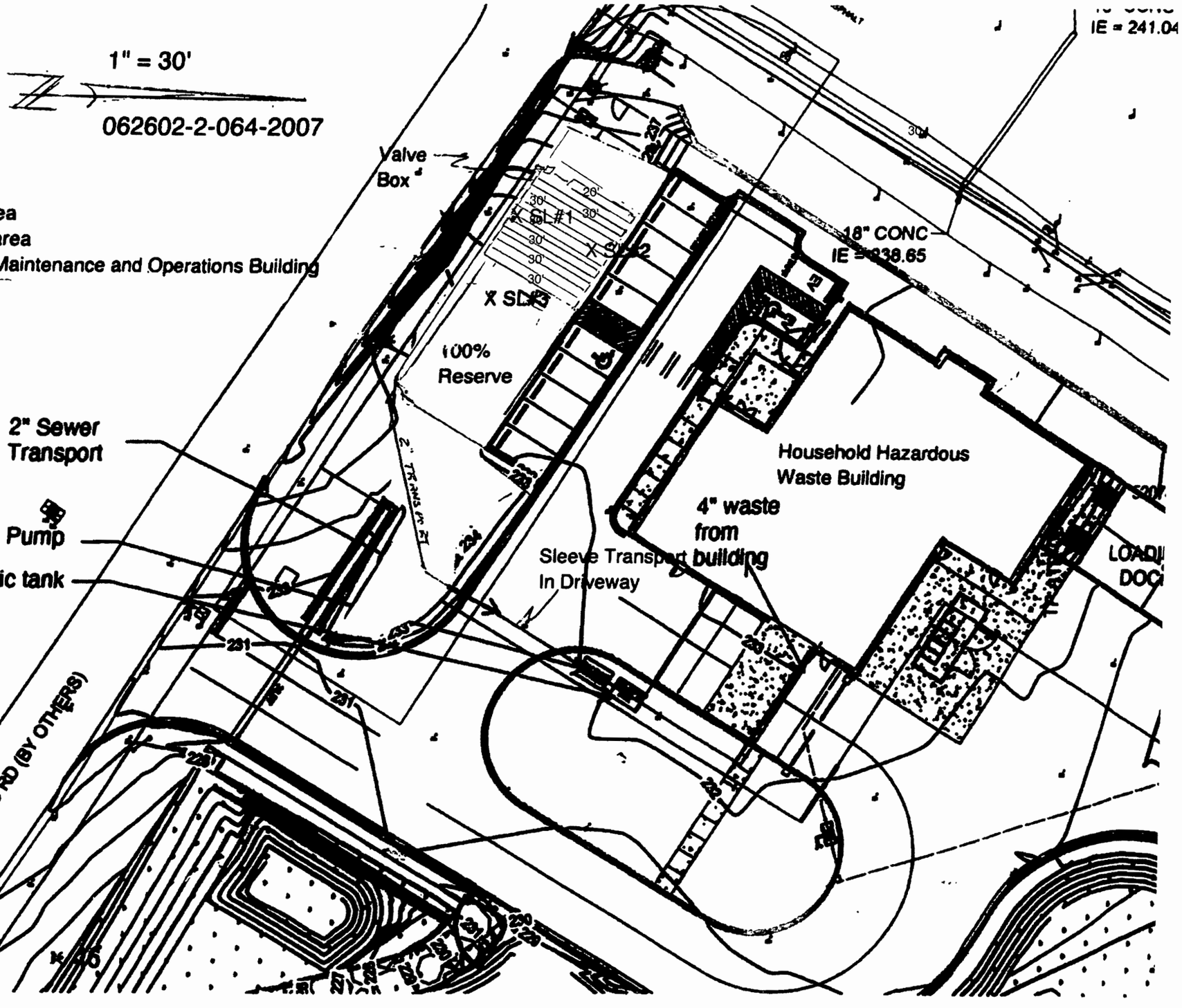
A. Percent Slope in Primary: 3 %
B. Maximum Trench Depth: 6 inches (Downslope Side Measurements)
C. Vertical Separation: 18 inches
D. Trench Width: 36 inches
E. Additional Cover Required: 16 inches

1" = 30'

062602-2-064-2007

There are no power lines in the drain field area
The water lines are >10' from the drain field area
The pump tank will receive effluent from the Maintenance and Operations Building

Suggest one 20' leg and six 30' legs



JAN 30 2023

PUBLIC DISTRICT

WASTEWATER TREATMENT SYSTEM
STATE OF WASHINGTON
5100333
THOMAS E. WEAVER
LICENSED DESIGNER
EXPIRES 01/25/2025

APPROVED

FOR SEWAGE AND WATER ONLY

SEE ENLARGEMENT

Detail Area

Household Hazardous Waste Building

For 2" Transport from Maintenance and Operations building use polyfusion or sleeving
Polyfusion recommended
Transport terminates in pump tank at Household Waste Building

Waterline Crossing
Follow KPHD Regs.
If plans change and other crossing occur, follow Regs for each crossing

RECEIVED
NOV 16 2022
KITSAP PUBLIC HEALTH DISTRICT

Bond Rd

2" Transport

2" Transport

Maintenance and Operations Building

Tanks for M & O Building

FUEL ISLAND

VEHICLE WASH

FUEL TANKS

SANDER BOX INSERT RACK

MISC. STORAGE

APPROVED

FOR SEWAGE AND WATER ONLY

062602-2-064-2007

HORZ SCALE 50' 0' 50' 100' IN FEET

STATE WASTEWATER MANAGEMENT SYSTEM DESIGNER STATE OF WASHINGTON
5100333
THOMAS E. WEAVER
LICENSED DESIGNER
EXPIRES 11/25/2023

Site Plan Requirements Checklist		
All site plans shall be clearly and accurately drawn to 1"=20', 30', 40' or 50' scale on paper no larger than 11" x 17" and must indicate all of the following information. Use this checklist to ensure all necessary elements are included in the site plan.		
Parcel Number		
Shown	N/A	General Property Information:
☐		Property lines and dimensions.
☐		Elevations of property and the direction of natural drainage (or contour lines).
☐	☐	Cut banks 5' or more in height.
☐		Site plan scale and North arrow.
☐	☐	Streams, creeks, wetlands with surface water, marine waters, lakes and ponds and their associated high-water lines.
Shown	N/A	Existing Property Improvements:
☐	☐	Location and labels of all existing structures.
☐	☐	Location of all existing public and private wells and their well radii, including those wells on adjacent properties within 100' of property lines.
☐	☐	Location of all existing drainfields, including the 10' "No Build Zone" as well as the locations of existing drainfields on adjacent properties within 100' of any well.
☐	☐	Identify all stormwater zones around wells and septic systems.
☐	☐	Location of existing drainage facilities, including all sub-surface infiltration systems.
☐	☐	Location of all existing and abutting roadways, driveways, and easements.
☐	☐	Location of all existing water, sewer and utility lines.
Shown	N/A	Proposed Property Improvements:
☐	☐	Location and dimensions of all proposed structures or building envelopes in relation to property lines, other structures, etc.
☐	☐	Location of all proposed public and private wells, including their 100' well radii and all water lines.
☐	☐	Location of all proposed septic tanks, pump tanks, pre-treatment units, and drainfields, including the 10' "no build" zone.
☐	☐	Identify all stormwater zones around wells and septic systems.
☐	☐	Location of all proposed parking areas, driveways, sidewalks, & road approaches.
☐	☐	Location of all proposed water, sewer and utility lines.

Parcel is on the corner of Bond Rd and Lamrid Road

Lamrid Rd is the first right turn off of Bond going toward Kingston

It is a new road and has no signs but it is constructed.

You will note the road only allows right turns in to and out of Lamrid Rd

Drain field area lines just off of Lamrid Rd

Note three pink and blue ribbons on the left of Lamrid Rd lying between soil logs 1 & 3 and fairly close to Bond Rd

RECEIVED

JAN 30 2023

KITSAP PUBLIC HEALTH DISTRICT

This page intentionally left blank

KITSAP PUBLIC HEALTH DISTRICT

RECEIVED
NOV 16 2022
KITSAP PUBLIC

Environmental Health
345 6th Street, Suite 300
Bremerton, WA 98337
360-337-5235

Memo #: 1298141
Date Applied: 11/16/22
Fee paid: $145
Clerks initials: CF

DRINKING WATER / ONSITE SEWAGE WAIVER REQUEST FORM

Waiver Request From (Please check the following in regard to which Regulations are the subject of the waiver):

- [x] **Local Septic Regulations (KCBOH Ordinance No. 2008A-1)**
- [ ] **Local Drinking Water Regulations (KCBOH Ordinance No. 1999-6)**

Section I. *(Completed by Applicant)*

(1) Name: OTAK Inc

(2) Site Address: Corner of Bond Rd and Lamrid Rd

(3)Tax Parcel No.: 062602-2-064-2007

(4) Regulatory Requirement: 246-272A-0230(2)(g)(I) Table IV Treatment standard B with timed dosing for soil types 3-6 with <24" vertical separation

(5) Waiver Requested: Treatment standard E pressure with timed dosing type 4 soils 18" separation

(6) Waiver Justification and Mitigation: No well or surface water within 200' down slope of drainfield
No reduction in Table IV horizontal setbacks -
Meets method 1 - system to have M&M with annual inspections
No additional waivers - no increase in loading rate and dosing volumes within 5% lateral to lateral

Section II. *(Completed by Kitsap Public Health Officer)*

(7) Review Criteria: Class B antena

(8) Mitigation Measures (in addition to those proposed in Section I.:

(9) Comments/Conditions of Approval: meets Class B.

(10) Type of Waiver: ☐ Class A ☒ Class B ☐ Class C ☐ Local

Section III. *(Completed by Kitsap Public Health Officer)*

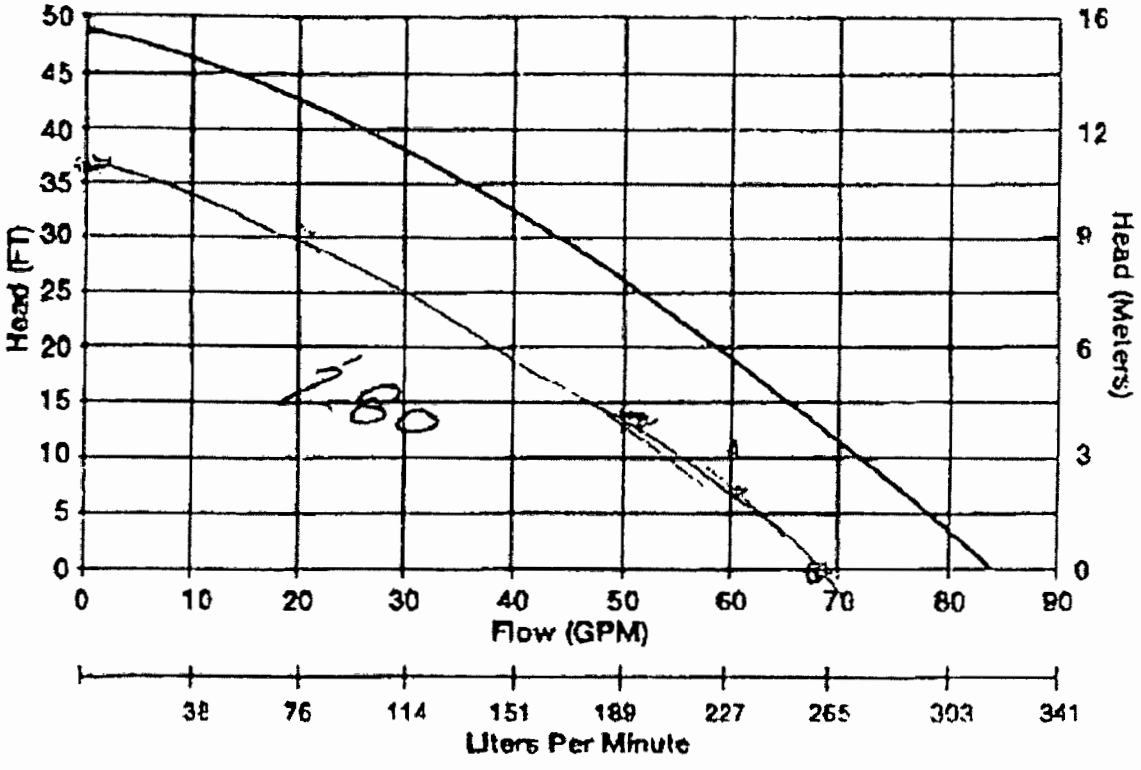
This Waiver Request has been reviewed according to the applicable provisions of Chapter 246-272 WAC or KCBOH Ordinance No. 2008A-1 or 1999-6. The review criteria applied, and the mitigation measures proposed and/or required, have been evaluated for their ability to provide public health protection at least equal to that provided by the regulations.

This Waiver Request is: ☒ **Approved/Granted** (Subject to the above Conditions of Approval)
☐ **Denied**
☐ **Accepted for Non-Conforming Onsite Sewage System**

KPHD Health Office Signature: _____ Date: 2/1/23

KPHD Health Officer Name: Kimberly Jones, RS

Performance Curve: 290-Series



Recommend Liberty 280 Pump

ONSITE WASTEWATER TREATMENT SYSTEM
STATE OF WASHINGTON
5100333
THOMAS E. WEAVER
LICENSED DESIGNER
EXPIRES 01/25/2025

3/16" Orifices @ 2' residual head = .59
2" Transport line @ 40gpm = .027' head/lineal ft
Every 90° = .162' head Every 45° = .07' head

Number of orifices 40 X .59 = 24 GPM

Transport loss 2 + Fitting loss _____ + elevation life 4 + 2' residual = 10

RECEIVED
JAN 30 2023
KITSAP PUBLIC
HEALTH DISTRICT

Allied Design Inc.
3912 Steelhead Dr NW
Bremerton, Wa 98312
(360) 620-7054

January 30, 2023

Kitsap Public Health Department

Re; Designed Sewage flow for Kitsap County North Maintenance Shop
On the corner of Bond Rd and Lamrid Rd
Tax Parcel # 062602-2-064-2007

Projected Personnel In Future Years

Road Operations

3 Supervisors
3 Mechanics
30 Staff generally gathering equipment and materials at the beginning and end of each day

Household Hazardous Waste Collection Facility

5 Staff

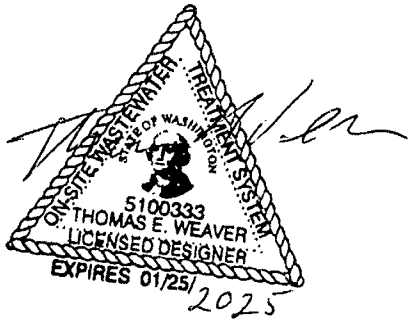
This would be eleven full time on site staff and 30 at the beginning and end of each day.
Counting the 30 part time employees as five full time employees this would constitute an equivalent of 16 individuals.

16 individuals X 15 gallons per day per person would demonstrate a sewage load of 240 gpd.

Designer is recommending an additional 50% allowance for any extreme periods, making the actual design load to be 360 gpd.

Thank you;

RECEIVED
JAN 30 2023
KITSAP PUBLIC
HEALTH DISTRICT



tweaver1431@gmail.com

Pressure Distribution North Kitsap Service Center

Two 1000 gallon septic tanks (One for each building)

Two 1,000 gallon pump tanks (One for each building)

High level & low level floats required for Household Waste Building
(Pump and alarm for M & O Building)

All tanks with water tight risers to the surface

Number of laterals, 7 spaced 5' O.C. (Suggest six 30' and one 20' laterals)

Lateral width 36"

Trench depth 6"

Total lateral length 200'

RECEIVED
JAN 30 2023
KITSAP PUBLIC
HEALTH DISTRICT

Transport line to be 2" dia. Sch 40 - 180' long from Household waste to valve box

Transport line 2" polyfusion from Maintenance and Operations building - This transport line crosses a water line and must per sleeved per KPHD Regs.

Laterals to be 1.25" diameter sch 40

Have access ports on lateral ends for inspection and cleaning - Sweeping 90's

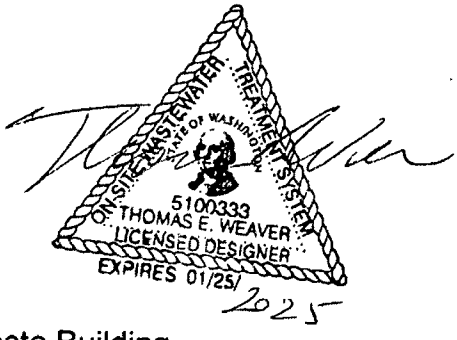
Residual squirt height - Minimum 24"

Orifices - size - 3/16" - Spacing 60" (40 orifices in total)

Orifices at 12 o'clock

Checkmate valve (or Equiv.)

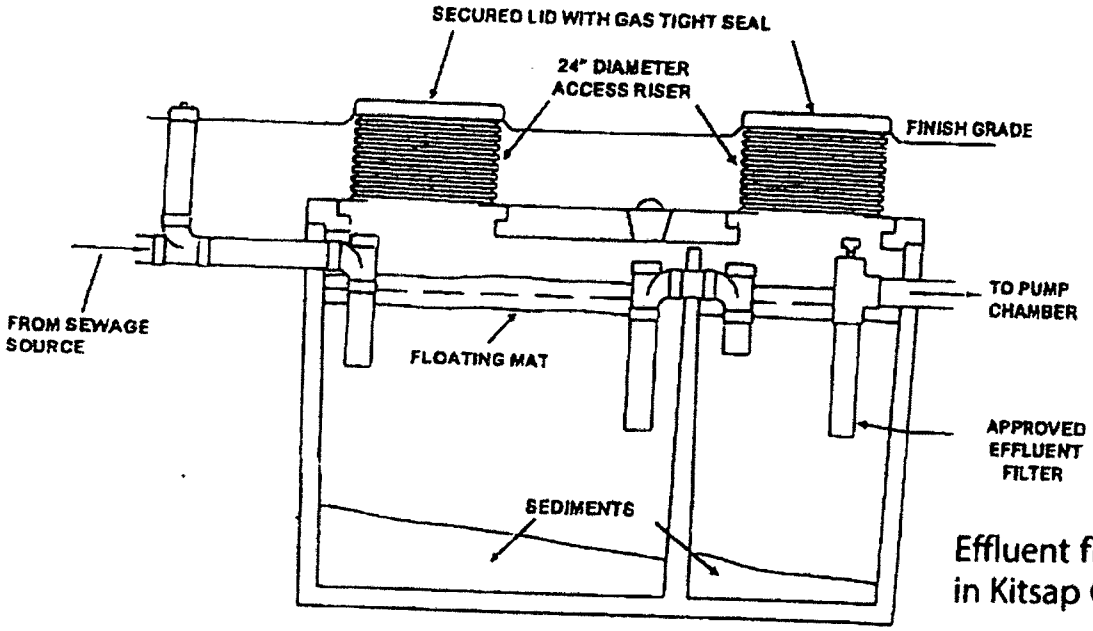
End Manifold with individual valves



Controller - SJE Rhombus or equivalent on Household Waste Building
On demand from Maintenance and Operations pumping to Household Waste install Tank Alert

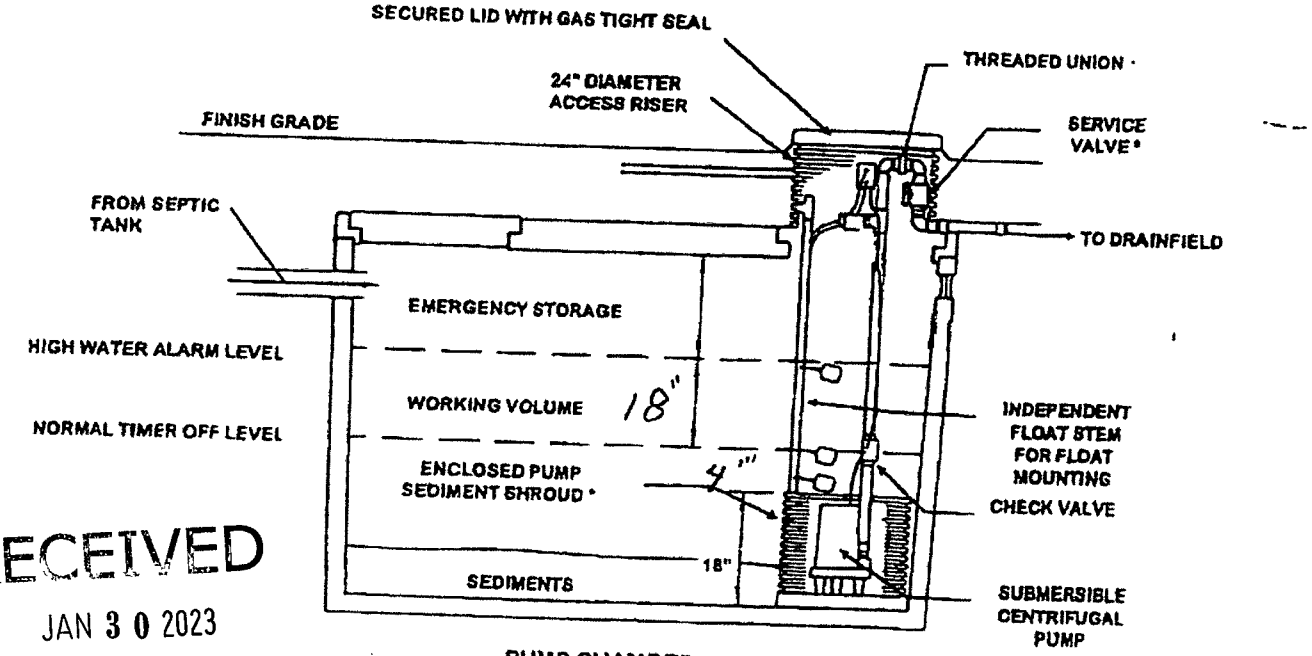
Timed dosing set for 6 times per day, 60 gallons per dose

Pump Liberty 280



Effluent filter optional in Kitsap County

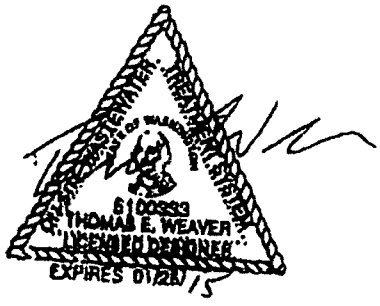
SEPTIC TANK (TYPICAL)



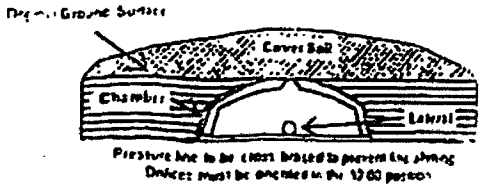
PUMP CHAMBER (TYPICAL)

RECEIVED
JAN 30 2023
KITSAP PUBLIC HEALTH DISTRICT

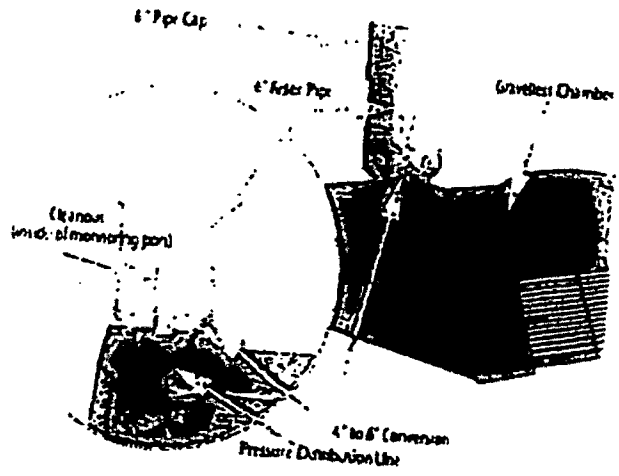
DRAWINGS MODIFIED FROM WSDH RS+G's



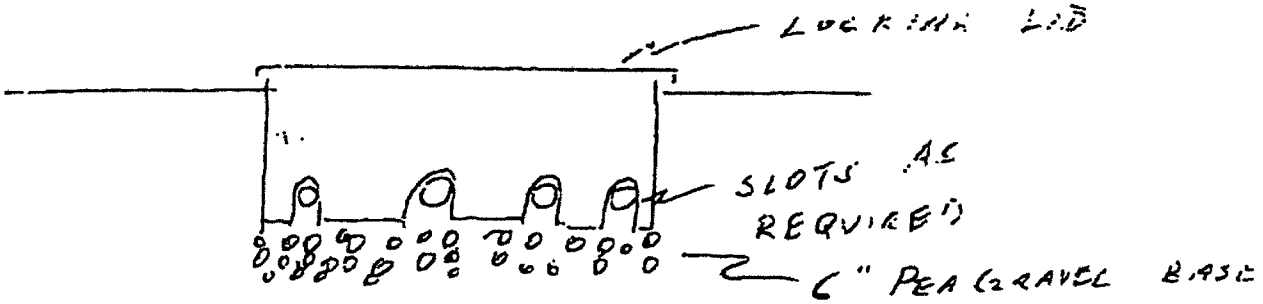
Typical, Not specific for this site



Gravelless Trench Detail
N.T.S.

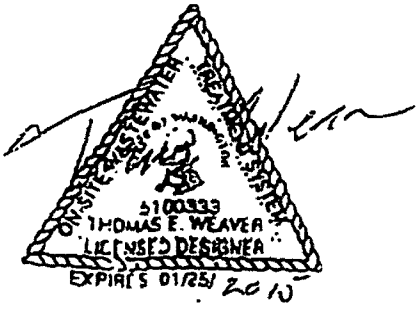


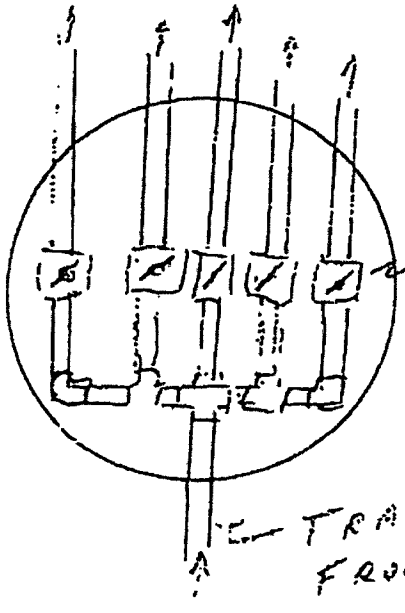
RECEIVED
JAN 30 2023
KITSAP PUBLIC
HEALTH DISTRICT



SPLITTER MANIFOLD SIDE VIEW RODENTS

TO DRAIN FIELD





SPLITTER MANIFOLD TOP VIEW

Figures

Typical, Not specific for this site

RECEIVED
JAN 3 0 2023
KITSAP PUBLIC
HEALTH DISTRICT

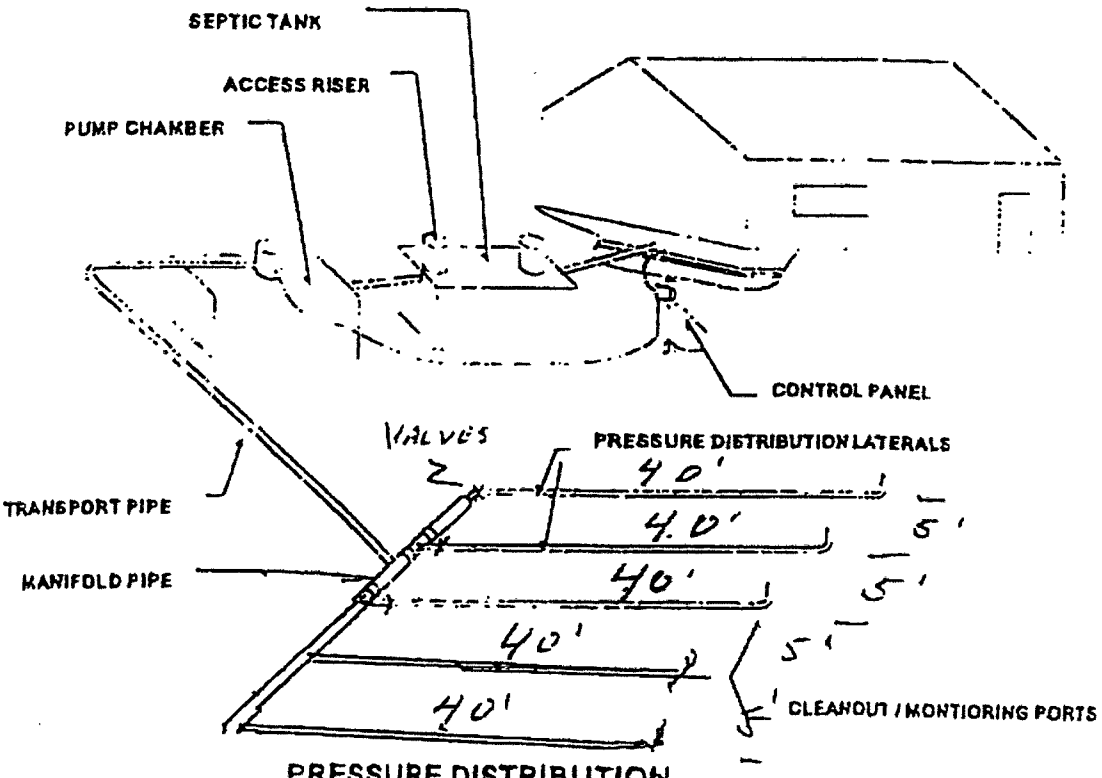
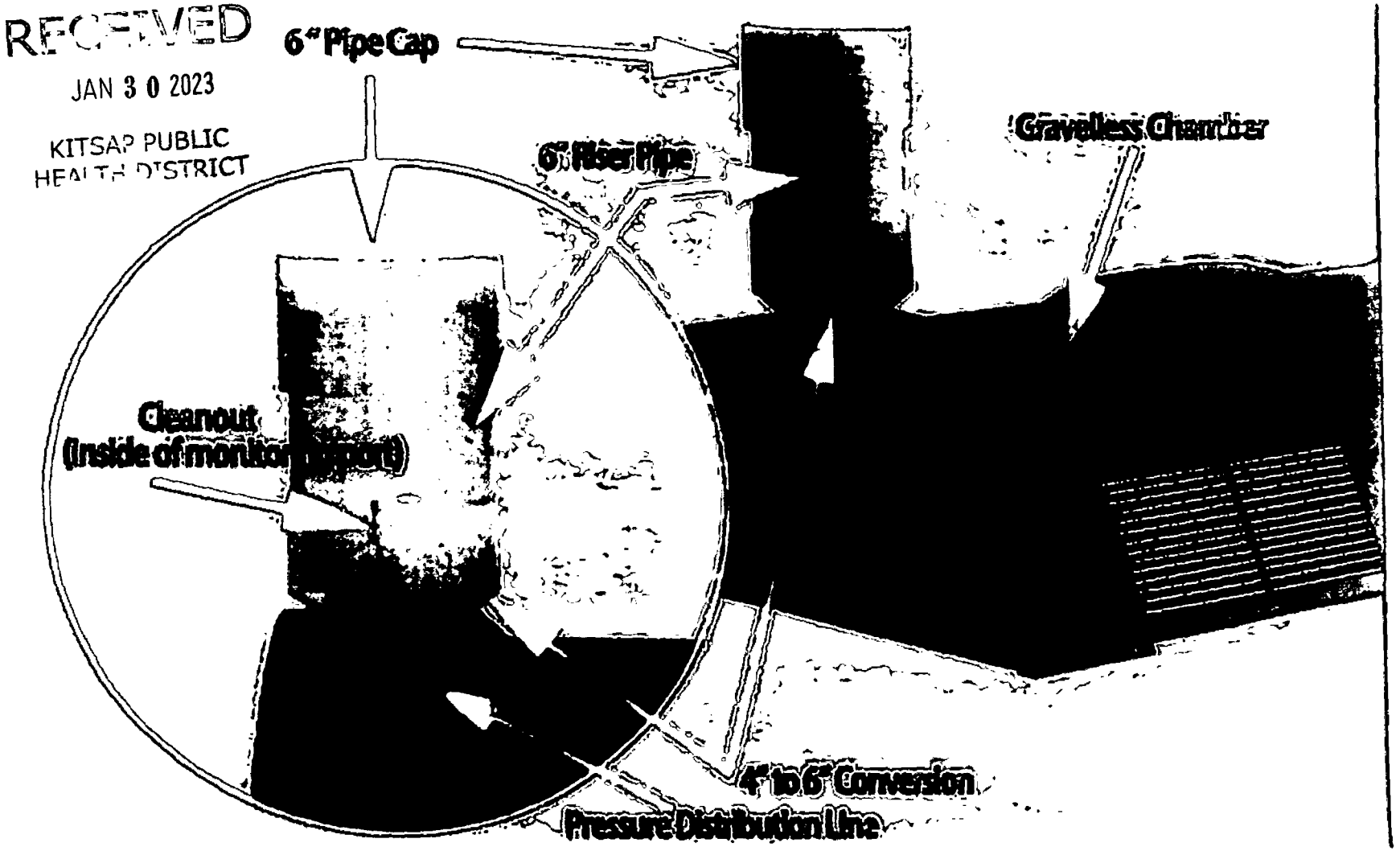


FIGURE 1

Pressure Distribution Cleanout/Monitoring Port Combo Example

RECEIVED
JAN 30 2023
KITSAP PUBLIC
HEALTH DISTRICT



***NOTE:** The Cap to the surface must be removable*

RECEIVED
APR 19 2023
KITSAP PUBLIC
HEALTH DISTRICT

KITSAP PUBLIC UTILITY DISTRICT #1
P.O. BOX 1989 - POULSBO, WA 98370
(360) 779-7656

BINDING WATER AVAILABILITY LETTER

System:	(03) Vinland, State ID No. 91923K; approved for "U" connections, currently serves		1476
Service Address:	23026 Bond Rd NE Poulsbo, WA 98370 Road Opreations Facility	Type:	Commercial
Tax Lot #:	032602-2-064-2007	Street Lts: NO	Area:

This Binding Water Availability Letter guarantees water service to the subject property.
This Binding Water Availability Letter has no expiration date.

Capital Facilities Charge :	$8,000.00 CFC x 3.6 ERU	ERU's	3.6	$28,800.00
Service Install Fee:		Meter Size	1 1/2"	$1,500.00
Square Footage Payback		SF of Lot		$0.00
Bainbridge Island Utility Tax (6%)				0.00
Sub Total:				$30,300.00
			NO	$0.00
Total Charges :				**$30,300.00**

Owner Name :	Kitsap County Public Works C/O Jacques Dean jdean@kitsap.gov		
Owner Mailing Address:	614 Division Street, MS 26 Port Orchard, WA 98366		
Owner Phone: Home :	360.337.4671	Alternate:	mobil 360.509.1583

X	The undersigned property owner hereby agrees to comply with all rates, rules and regulation as approved by the Commissioners of Kitsap PUD relative thereto.
X	It is understood and agreed that any unpaid charges shall become a lien on the property served. The PUD shall not be responsible for the pressure nor the volume of flow greater or less than normal to the tap location.
YES	YES / NO : This connection has or plans to install an irrigation or sprinkler system The District Must be notified prior to installation of any irrigation or sprinkler system. Failure to notify the District of such installation may result in termination of water service.
	Service installation may require up to 60 working days.
	Service is requested as soon as service installation has been completed.
X	Service will be locked off until owner requests initiation of service. **Locked off services are subject to a "Ready to Serve" charge. Should the lock be removed and/or water used prior to notifying the District to initiate service, billing will become retroactive to date of this binding letter and charges will be billed to the party signing this letter regardless of circumstances which resulted in unapproved use of service.**
NO	YES / NO: **There is an existing well on the property. The owner is required to either decommission the well *OR* have it approved for use by the Health District.**

Signature: Michael J Flaherty Agent : Mike Flaherty Payment Amt : $30,300.00

Check # : 3849972 Date : 4/18/2023 Signature:

KITSAP PUBLIC UTILITY DISTRICT #1

P.O. BOX 1989 - POULSBO, WA 98370

(360) 779-7656

BINDING WATER AVAILABILITY LETTER

This form must be completed by the water purveyor, operations manager, water commissioner, or their designee.

For each commitment for a water hook-up, please complete the section below. Verbal approval over the phone and completion by any other person other than the authorized personnel for the water supply will not be accepted.

The Public Water System

(03) Vinland, State ID No. 91923K; approved for "U" connections, currently serves **1476**

is capable of supplying, and will supply water to:

Kitsap County Public Works C/O Jacques Dean **jdean@kitsap.gov**

for 1 (one) connection located at:

032602-2-064-2007

This connection is to be used for:

Commercial

This Binding Water Availability Letter has no expiration date.

Agent's Name: Mike Flaherty

Signature: Michael J Flaherty

Title: Utility Manager

Date 4/18/2023

RECEIVED

APR 19 2023

KITSAP PUBLIC HEALTH DISTRICT

KITSAP PUBLIC UTILITY DISTRICT #1
P.O. BOX 1989 - POULSBO, WA 98370
(360) 779-7656

BINDING WATER AVAILABILITY LETTER

System:	(03) Vinland, State ID No. 91923K; approved for "U" connections, currently serves		1474
Service Address:	23026 Bond Rd NE Poulsbo, WA 98370 Household Hazardous Waste	Type:	Commercial
Tax Lot #:	032602-2-064-2007	Street Lts: NO	Area:

This Binding Water Availability Letter guarantees water service to the subject property.

This Binding Water Availability Letter has no expiration date.

Capital Facilities Charge :	$8,000.00 CFC x 2.2 ERU	ERU's	2.2	$17,600.00
Service Install Fee:		Meter Size	1"	$510.00
Square Footage Payback		SF of Lot		$0.00
Bainbridge Island Utility Tax (6%)				0.00
Sub Total:				$18,110.00
			NO	$0.00
Total Charges :				**$18,110.00**

Owner Name :	Kitsap County Public Works C/O Jacques Dean	jdean@kitsap.gov	
Owner Mailing Address:	614 Division Street, MS 26 Port Orchard, WA 98366		
Owner Phone: Home :	360.337.4671	Alternate:	mobil 360.509.1583

X	The undersigned property owner hereby agrees to comply with all rates, rules and regulation as approved by the Commissioners of Kitsap PUD relative thereto.
X	It is understood and agreed that any unpaid charges shall become a lien on the property served. The PUD shall not be responsible for the pressure nor the volume of flow greater or less than normal to the tap location
YES	YES / NO : This connection has or plans to install an irrigation or sprinkler system. The District Must be notified prior to installation of any irrigation or sprinkler system. Failure to notify the District of such installation may result in termination of water service.
	Service installation may require up to 60 working days.
	Service is requested as soon as service installation has been completed.
X	Service will be locked off until owner requests initiation of service. **Locked off services are subject to a "Ready to Serve" charge. Should the lock be removed and/or water used prior to notifying the District to initiate service, billing will become retroactive to date of this binding letter and charges will be billed to the party signing this letter regardless of circumstances which resulted in unapproved use of service.**
NO	YES / NO: **There is an existing well on the property. The owner is required to either decommission the well *OR* have it approved for use by the Health District.**

Signature: Michael J Flaherty Agent : Mike Flaherty Payment Amt : $18,110.00

Check # : 3849725 Date : 4/18/2023 Signature:

KITSAP PUBLIC UTILITY DISTRICT #1

P.O. BOX 1989 - POULSBO, WA 98370

(360) 779-7656

BINDING WATER AVAILABILITY LETTER

This form must be completed by the water purveyor, operations manager, water commissioner, or their designee.

For each commitment for a water hook-up, please complete the section below. Verbal approval over the phone and completion by any other person other than the authorized personnel for the water supply will not be accepted.

The Public Water System

(03) Vinland, State ID No. 91923K; approved for "U" connections, currently serves **1474**

is capable of supplying, and will supply water to:

Kitsap County Public Works C/O Jacques Dean **jdean@kitsap.gov**

for 1 (one) connection located at:

032602-2-064-2007

This connection is to be used for:

Residential

This Binding Water Availability Letter has no expiration date.

Agent's Name: Mike Flaherty

Signature: Michael J Flaherty

Title: Utility Manager

Date 4/18/2023

KITSAP PUBLIC
HEALTH DISTRICT

345 6th Street, Suite 300
Bremerton, WA 98337
360-728-2235

Notice of Pending Building Site Application with Public Water Supply

02/02/2023

OTAK INC
11241 Willow Rd #200
Redmond, WA 98052

Tax ID: 062602-2-064-2007
Site Address: 23026 BOND RD NE
Memo #: 123027
Water Source Type: Public
Water System Name: North Peninsula

Dear Applicant,

This checklist expires on 12/15/2025.

Your Building Site Application has been reviewed and a determination made that the soils and/or septic system plans have been given preliminary approval. However, the items listed below need to be submitted for review prior to final approval of your application may be granted. Your application has been placed in our pending files.

1. A current, three-year water availability letter from an approved public water system must be submitted. The water availability letter must be for a **Binding** commitment for water service, and must not expire 90 days prior to the building site application expiration date.

For prompt review, please submit documentation to ossdw@kitsappublichealth.org.

Please be aware that further review of your application cannot proceed until these items are submitted to the Health District. Additional information may be requested in the future based upon continued review.

You may track the status of your application online at www.kitsappublichealth.org; click on the "Application status" button on the bottom of the page.

If you have any questions regarding this pending letter you may contact me at 360-728-2334 or christine.bronder@kitsappublichealth.org.

Thank you for your cooperation.

Sincerely,

Christine Bronder
Environmental Health Specialist
Drinking Water and Onsite Sewage Program

cc: Allied Design Inc.

23026 BOND RD NE Poulsbo

CHRONOLOGICAL CONTROL SHEET
Building Site Application - ReDesign

Applicant: **OTAK INC**
Tax ID: **062602-2-064-2007**
Contractor: **Allied Design Inc.**

Memo: **123027** BP: **N/A** DCD-LU: **N/A**

RECEIVED ON	INITIALS	ACTION TAKEN/COMMENTS	ROUTE TO	DATE
01/30/2023	CRB	Received online, BSA pending with CB redesign without site visit	CB	01/30/2023
		Stake out required prior to installation		
2/2/23	CB	review w/ KJ. OSS approved pending BWAL		
4/19/23	CB	dw approved	PP	
4/21/23	CB	P	Scan	4/4/23

Printed: 1/30/2023 2:12 PM

KITSAP PUBLIC
HEALTH DISTRICT

345 6th Street, Suite 300
Bremerton, WA 98337
360-728-2235

HEALTH OFFICER DECISION

Application Type: Building Site Application - Commercial

Memo #: 129814
Tax ID #: 062602-2-064-2007
RP ACCT ID: 2646388
Expiration: 12/15/2025

062602-2-064-2007

Property Information

23026 BOND RD NE
Poulsbo WA 98370

Contractor of Record

Contractor Name: Allied Design Inc.
Contractor Phone #: (360) 620-7054

Applicant

OTAK INC
11241 Willow Rd #200
Redmond WA 98052

Waivers

Waiver Type	Memo #	Notes
Waiver Class B	1298141	18" of vertical separation for pressure distribution.

Health Officer Decision for Onsite Sewage System

Denied (See Conditions Below)	Name of Inspector: *Christine Bronder*	Date: *04/19/2023*
See redesign memo #123027		

Health Officer Decision for Water Supply

Denied (See Conditions Below)	Name of Inspector: *Christine Bronder*	Date: *04/19/2023*

OTAK INC

Final Decision: Denied

This page intentionally left blank

KITSAP PUBLIC
HEALTH DISTRICT

345 6th Street, Suite 300
Bremerton, WA 98337
360-728-2235

RECEIVED
NOV 16 2022
KITSAP PUBLIC
HEALTH DISTRICT

BUILDING SITE APPLICATION

FOR WATER SUPPLY & ONSITE SEWAGE SYSTEM

Submittal Date	Memo Number	Review Fee	S.S.I.
11/16/22	129814	$955	CB

BUILDING SITE INFORMATION

Building Site Address – Street, City, Zip Code:
23026 Bond Rd; Poulsbo 98370

Assessor Tax Account Number:
062602-2-064-2007

Property Size:
681,278

Lot Number:

APPLICANT INFORMATION

First & Last Name
OTAK Inc.

Phone Number:
(425) 739-4219

E-Mail:
jeff.massie@otak.com

Mailing Address – Street, City, State, Zip Code:
11241 Willow Rd #200; Redmond, WA 98052

APPLICATION GENERAL PROPOSAL

Application Type:
- ☑ New
- ☐ Repair (no building permit needed)
- ☐ Modification (building permit needed)
- ☐ Building Clearance with Compliance

Application Use Type:
- ☐ Residential
- ☐ Multi-Family
- ☐ Community
- ☑ Commercial

Application Water Type:
- ☑ Public Water
- ☐ Private Water (residential only)

☐ *This is a Redesign (describe what is being changed) OR a Building Clearance with Compliance (describe proposal)*

APPLICANT/AGENT & DESIGNER ACKNOWLEDGEMENT

I certify that (1) the information contained in this application is true and accurate to the best of my knowledge; (2) the application represents my intended use of this property; and (3) any related building permits for which I apply for will be consistent with the plans and specifications contained in this application.

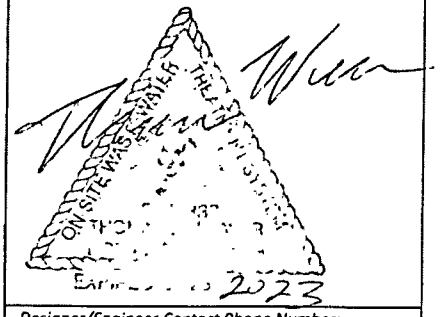
I acknowledge and understand that I, along with my contractors, are responsible for adhering to the conditions of approval of this application and are responsible for conforming to applicable Kitsap County Board of Health ordinances and Washington State Department of Health regulations for onsite sewage systems and water supply.

I acknowledge and understand that the design, location, and construction of my onsite sewage system and/or well is/are critical and of a sensitive nature, and I agree to protect these areas as required by the regulations.

I understand that once this application is submitted and/or approved, any changes to, or variations from, the information or conditions related to this plan may require a revised application submittal and/or could result in the revocation, denial, or suspension of this application or a related building permit and that this application will fully expire within 3 (three) years and 30 (thirty) days from the original date of application submittal.

I understand that I have the right to appeal the Health Officer's decision concerning this application pursuant to the regulations, and that approval of this application does not guarantee that a building permit will be issued.

Designer/Engineer Stamp



Applicant/Agent Signature

Date
11/15/2022

Designer/Engineer Contact Phone Number:
(360) 620-7054

Designer/Engineer E-Mail Address:
tweaver1431@gmail.com

Intake Notes – Health District Use Only

DENIED

DRINKING WATER & ONSITE SEWAGE SYSTEM SPECIFICATION SHEET

Assessor Tax Account Number: 062602-2-064-2007

A. DRINKING WATER SUPPLY INFORMATION

☐ Proposed
☑ Existing

☑ Public
☐ Private
☐ Individual
☐ 2-Party

System Name:

System ID:

ASSESSOR TAX ACCOUNT NUMBERS FOR PROPERTIES SERVED BY WELL

Water Connection 1 (Parcel with Well):

Water Connection 2 (Parcel connected to Well):

B. SOIL EVALUATION PROFILES

Soil Evaluation Date: 09/14/2022

SOIL LOG NUMBERS MUST CORRELATE WITH SITE PLAN – INDICATE TOTAL EXCAVATED DEPTH, SOIL TYPES, WATER TABLE LEVEL & DEPTH OF RESTRICTIVE LAYER

SOIL LOG #1	SOIL LOG #2	SOIL LOG #3	SOIL LOG #4
Downslope Side Measurements	Downslope Side Measurements	Downslope Side Measurements	Downslope Side Measurements
0-26" Sand Loam 26" Semi Compact	0-24" Sand Loam 24" Semi compact	Same as SL#1	

RECEIVED
NOV 16 2022
KITSAP PUBLIC HEALTH DISTRICT

C. DAILY FLOW – TANKAGE – TREATMENT

DESIGNED MAX SEWAGE FLOW: 240 Gallons Per Day

PROPOSED RESIDENTIAL BEDROOMS: Maximum Bedrooms

PROPOSED TREATMENT LEVEL: TL E

TRASH/SEPTIC/PUMP TANKS

Type	Size (gal)	QTY
☐ Trash Tank		
☑ Septic Tank	1,000	2
☑ Pump Tank	1,000	2
☐ Other		

ADVANCED TREATMENT INFORMATION

☐ Proprietary Advanced Treatment
Manufacturer:
Model:
☐ Non-Proprietary Advanced Treatment
Device Type:

D. DISPERSAL COMPONENT CONSTRUCTION

DISPERSAL COMPONENT SIZING

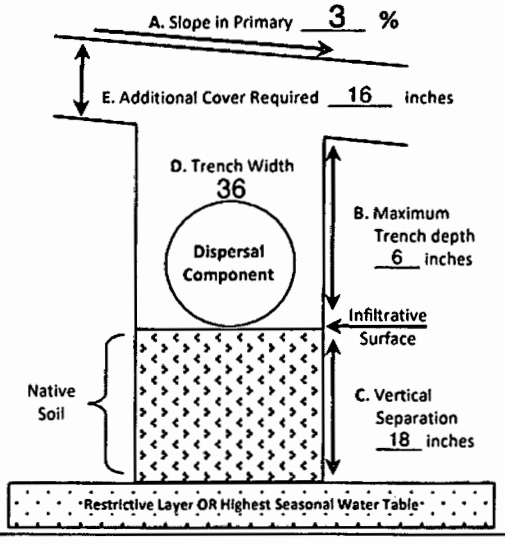
Hydraulic Loading Rate of Dispersal Area: .6

Minimum Dispersal Area (Sq. Ft.) In Primary: 400

Minimum Linear Feet or Dimensions: 135'

DISTRIBUTION METHOD

☐ Gravity Distribution
☑ Pressure Distribution
☐ Drip Irrigation
☐ Other:



TRENCH CONSTRUCTION PROFILE

A. Percent Slope in Primary: 3 %
B. Maximum Trench Depth: 6 inches (Downslope Side Measurements)
C. Vertical Separation: 18 inches
D. Trench Width: 36 inches
E. Additional Cover Required: 16 inches

DENIED

1" = 30'

062602-2-064-2007

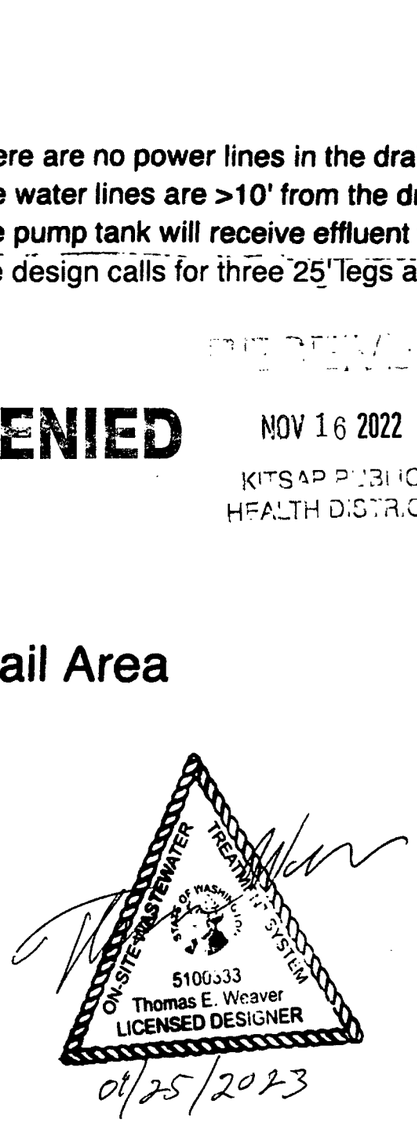
There are no power lines in the drain field area
The water lines are >10' from the drain field area
The pump tank will receive effluent from the Maintenance and Operations Building
The design calls for three 25' legs and three 20' legs

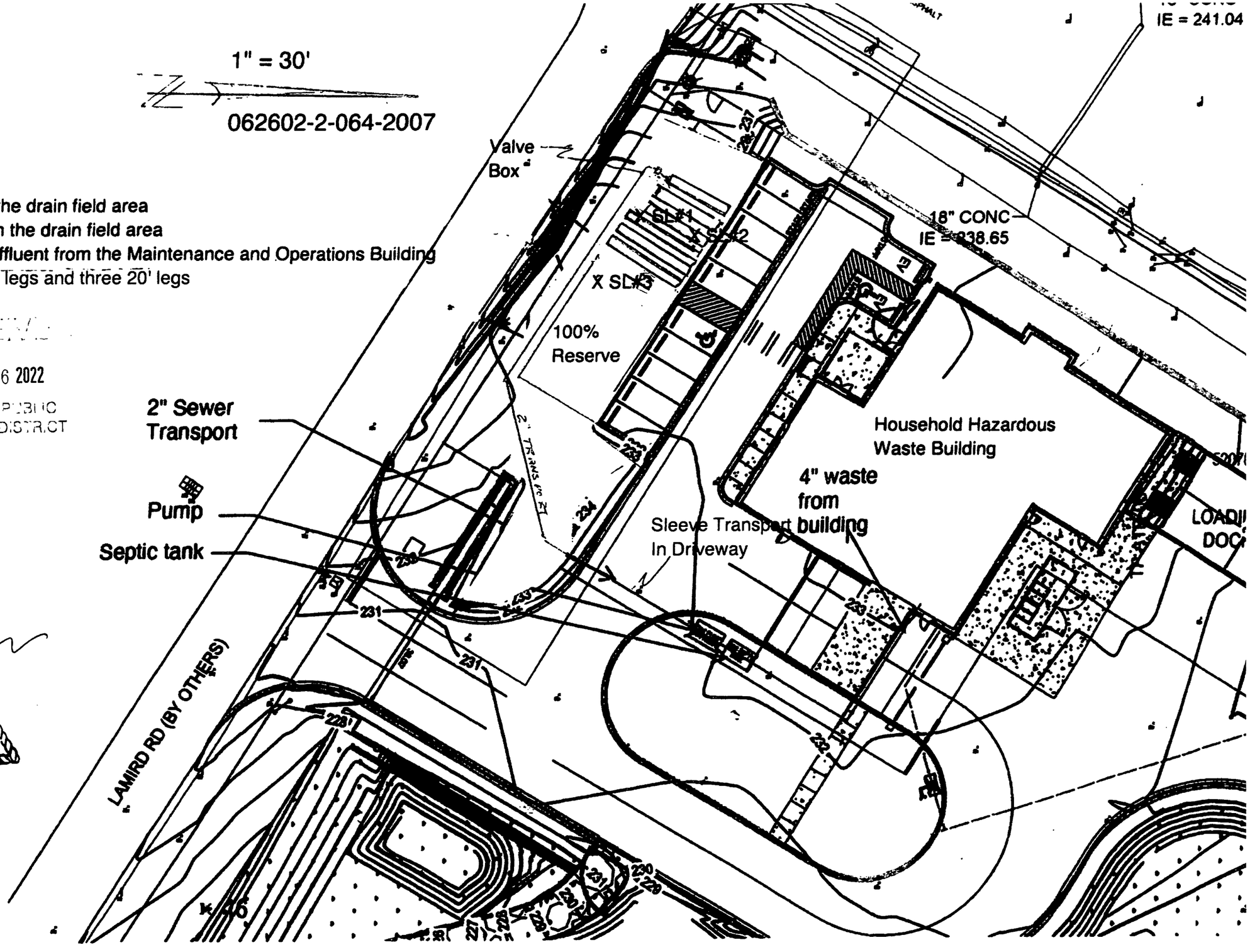
DENIED

NOV 16 2022

KITSAP PUBLIC
HEALTH DISTRICT

Detail Area





This page intentionally left blank

Site Plan Requirements Checklist

All site plans shall be clearly and accurately drawn to 1"=20', 30', 40' or 50' scale on paper no larger than 11" x 17" and must indicate all of the following information. Use this checklist to ensure all necessary elements are included in the site plan.

Parcel Number

Shown	N/A	General Property Information:
☐		Property lines and dimensions.
☐		Elevations of property and the direction of natural drainage (or contour lines).
☐	☐	Cut banks 5' or more in height.
☐		Site plan scale and North arrow.
☐	☐	Streams, creeks, wetlands with surface water, marine waters, lakes and ponds and their associated high-water lines.
Shown	**N/A**	**Existing Property Improvements:**
☐	☐	Location and labels of all existing structures.
☐	☐	Location of all existing public and private wells and their well radii, including those wells on adjacent properties within 100' of property lines.
☐	☐	Location of all existing drainfields, including the 10' "No Build Zone" as well as the locations of existing drainfields on adjacent properties within 100' of any well.
☐	☐	Identify all stormwater zones around wells and septic systems.
☐	☐	Location of existing drainage facilities, including all sub-surface infiltration systems.
☐	☐	Location of all existing and abutting roadways, driveways, and easements.
☐	☐	Location of all existing water, sewer and utility lines.
Shown	**N/A**	**Proposed Property Improvements:**
☐	☐	Location and dimensions of all proposed structures or building envelopes in relation to property lines, other structures, etc.
☐	☐	Location of all proposed public and private wells, including their 100' well radii and all water lines.
☐	☐	Location of all proposed septic tanks, pump tanks, pre-treatment units, and drainfields, including the 10' "no build" zone.
☐	☐	Identify all stormwater zones around wells and septic systems.
☐	☐	Location of all proposed parking areas, driveways, sidewalks, & road approaches.
☐	☐	Location of all proposed water, sewer and utility lines.

Parcel is on the corner of Bond Rd and Lamrid Road

Lamrid Rd is the first right turn off of Bond Rd going toward Kingston

It is a new road and has no signs but it is constructed.

You will note the road only allows right turns in to and out of Lamrid Rd

Drain field area lines just off of Lamrid Rd

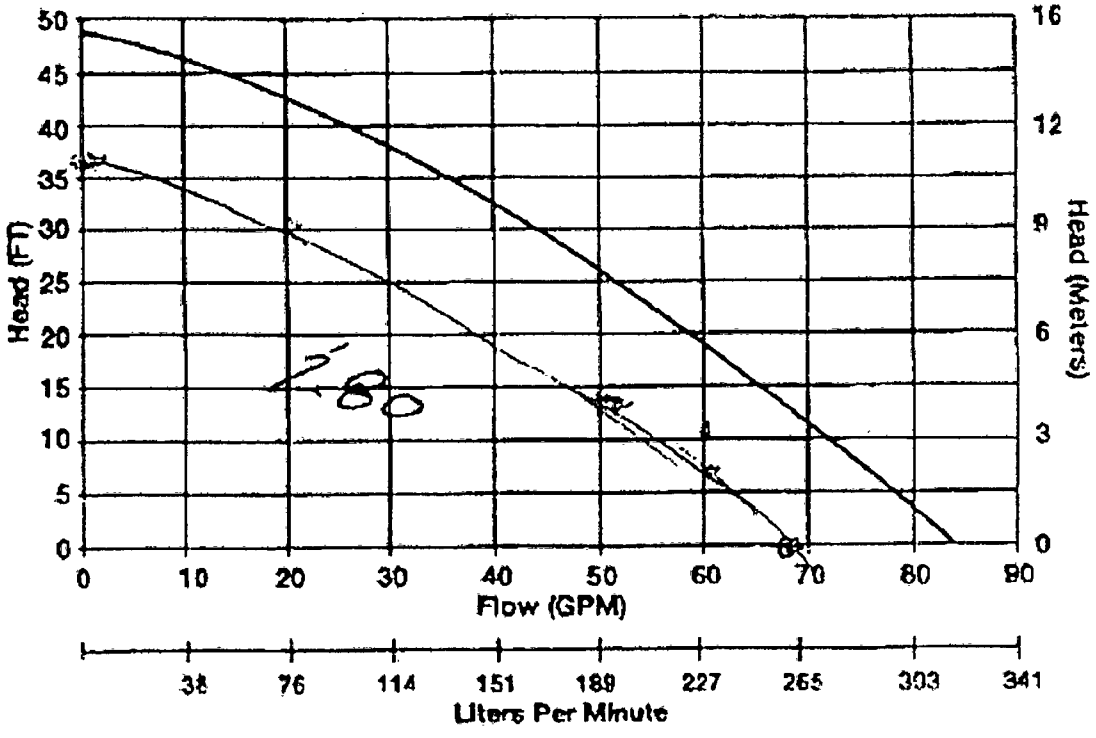
Note three pink and blue ribbons on the left of Lamrid Rd lying between soil logs 1 & 3 and fairly close to Bond Rd

RECEIVED

NOV 15 2022

KITSAP PUBLIC
HEALTH DISTRICT

Performance Curve: 290-Series



Recommend Liberty 280 Pump

3/16" Orifices @ 2' residual head = .59
2" Transport line @ 40gpm = .027' head/lineal ft
Every 90° = .162' head Every 45° = .07' head

Number of orifices 34 X .59 = 20 GPM

Transport loss 2 + Fitting loss 2 + elevation life 4 + 2' residual = 10

RECEIVED
NOV 16 2022
KITSAP PUBLIC
HEALTH DISTRICT

Pressure Distribution North Kitsap Service Center

Two 1000 gallon septic tanks (One for each building)

Two 1,000 gallon pump tanks (One for each building)

High level & low level floats required for Household Waste Building
(Pump and alarm for M & O Building)

All tanks with water tight risers to the surface

Number of laterals, 6 spaced 5' O.C. (Suggest three 25' and three 20' laterals)

Lateral width 36"

Trench depth 6"

Total lateral length 135'

RECEIVED
NOV 16 2022
KITSAP PUBLIC
HEALTH DISTRICT

Transport line to be 2" dia. Sch 40 - 180' long from Household waste to valve box

Transport line 2" polyfusion from Maintenance and Operations building - This transport line crosses a water line and must per sleeved per KPHD Regs.

Laterals to be 1.25" diameter sch 40

Have access ports on lateral ends for inspection and cleaning - Sweeping 90's

Residual squirt height - Minimum 24"

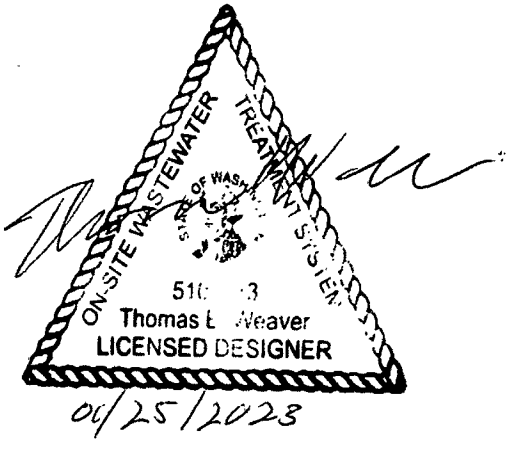
Orifices - size - 3/16" - Spacing 60" (34 orifices in total)

Orifices at 12 o'clock

Checkmate valve (or Equiv.)

End Manifold with individual valves

Vacuum breaker required

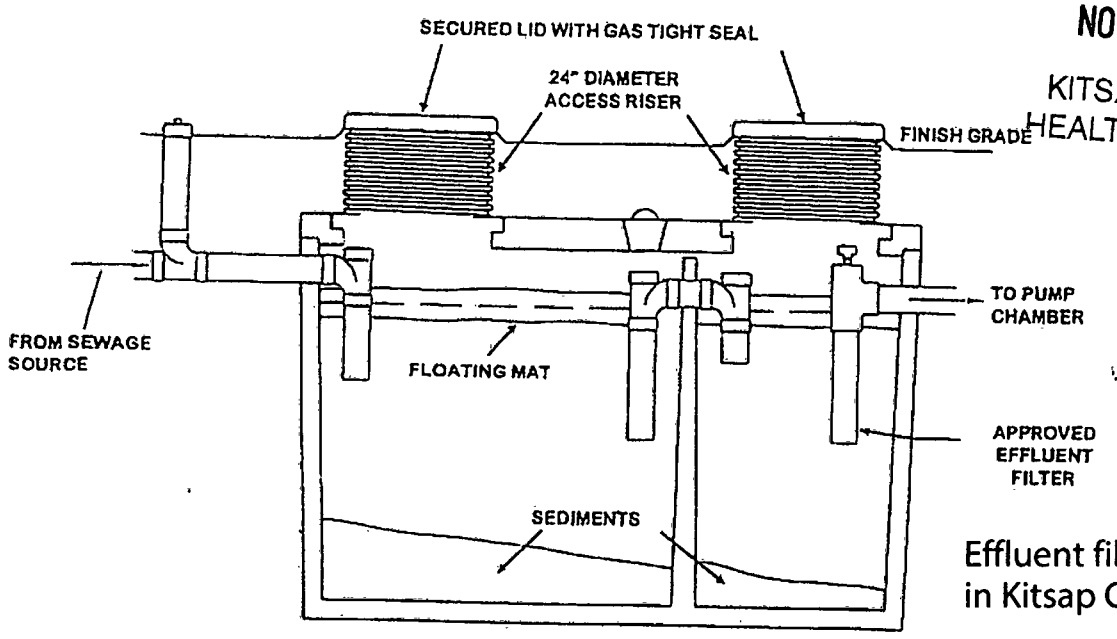


Controller - SJE Rhombus or equivalent on Household Waste Building
On demand from Maintenance and Operations pumping to Household Waste install Tank Alert

Timed dosing set for 6 times per day, 40 gallons per dose

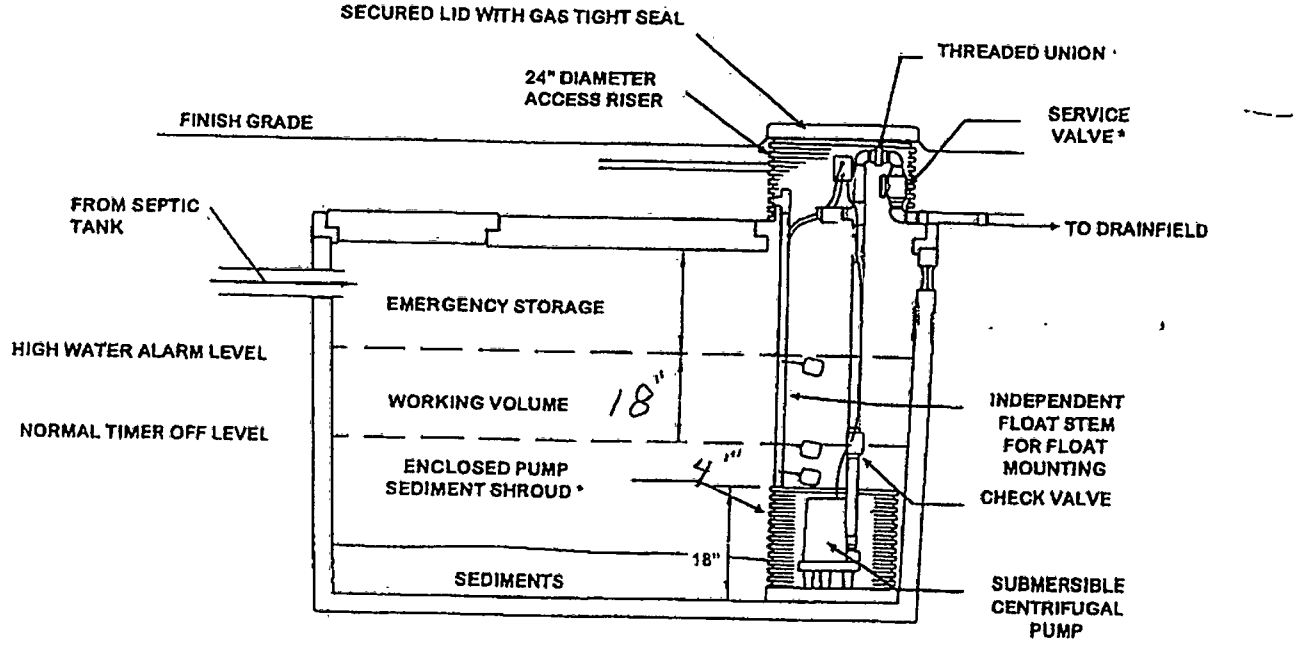
Pump Liberty 280

RECEIVED
NOV 16 2022
KITSAP PUBLIC
HEALTH DISTRICT



Effluent filter optional in Kitsap County

SEPTIC TANK
(TYPICAL)

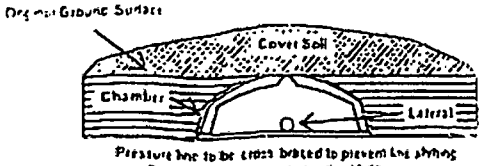


PUMP CHAMBER
(TYPICAL)

DRAWINGS MODIFIED FROM WSDH RS+G

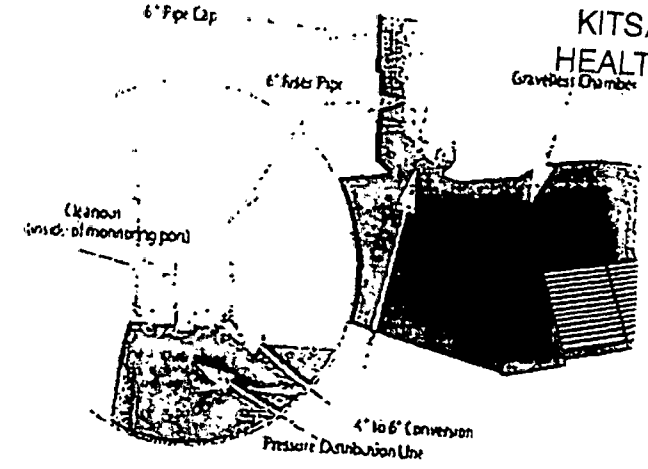
RECEIVED
NOV 16 2022
KITSAP PUBLIC
HEALTH DISTRICT

Typical, Not specific for this site

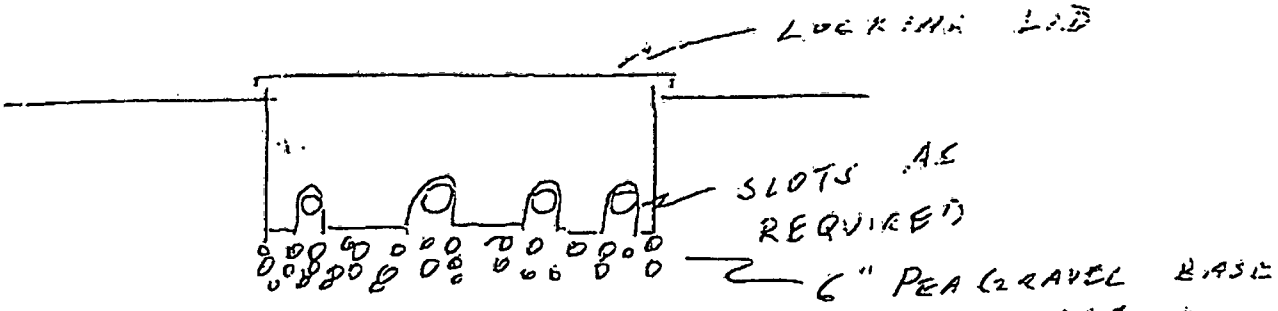


Pressure line to be cross braced to prevent line shifting
Orifices must be oriented in the 12:00 position

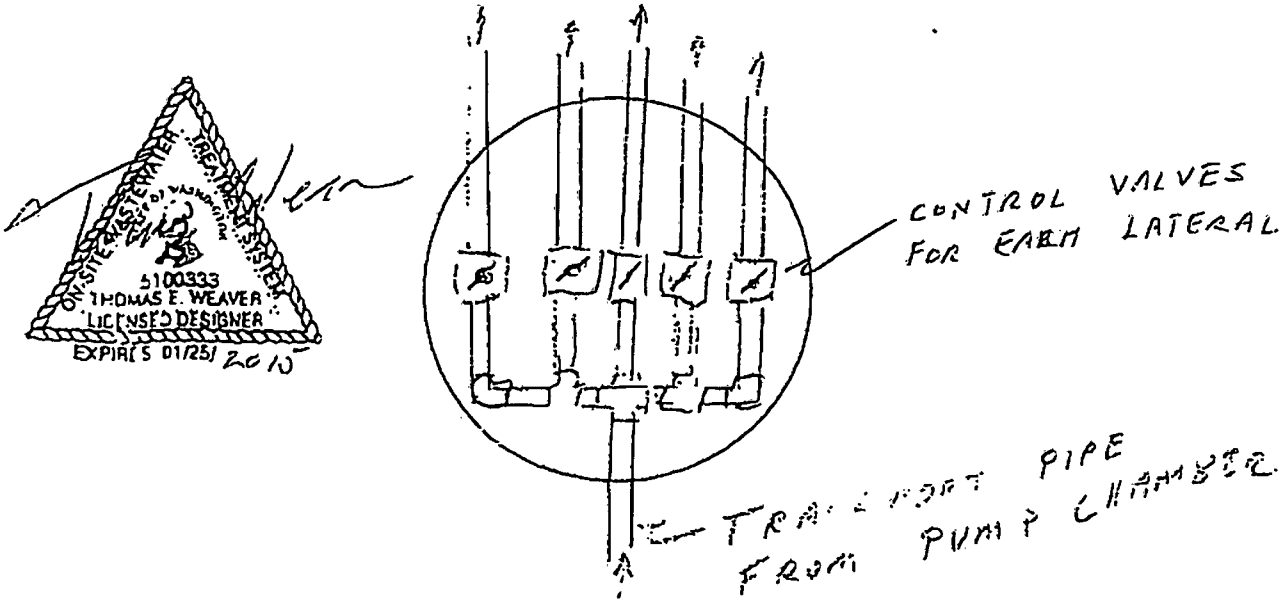
Gravelless Trench Detail
N.T.S.



NOTE [illegible]



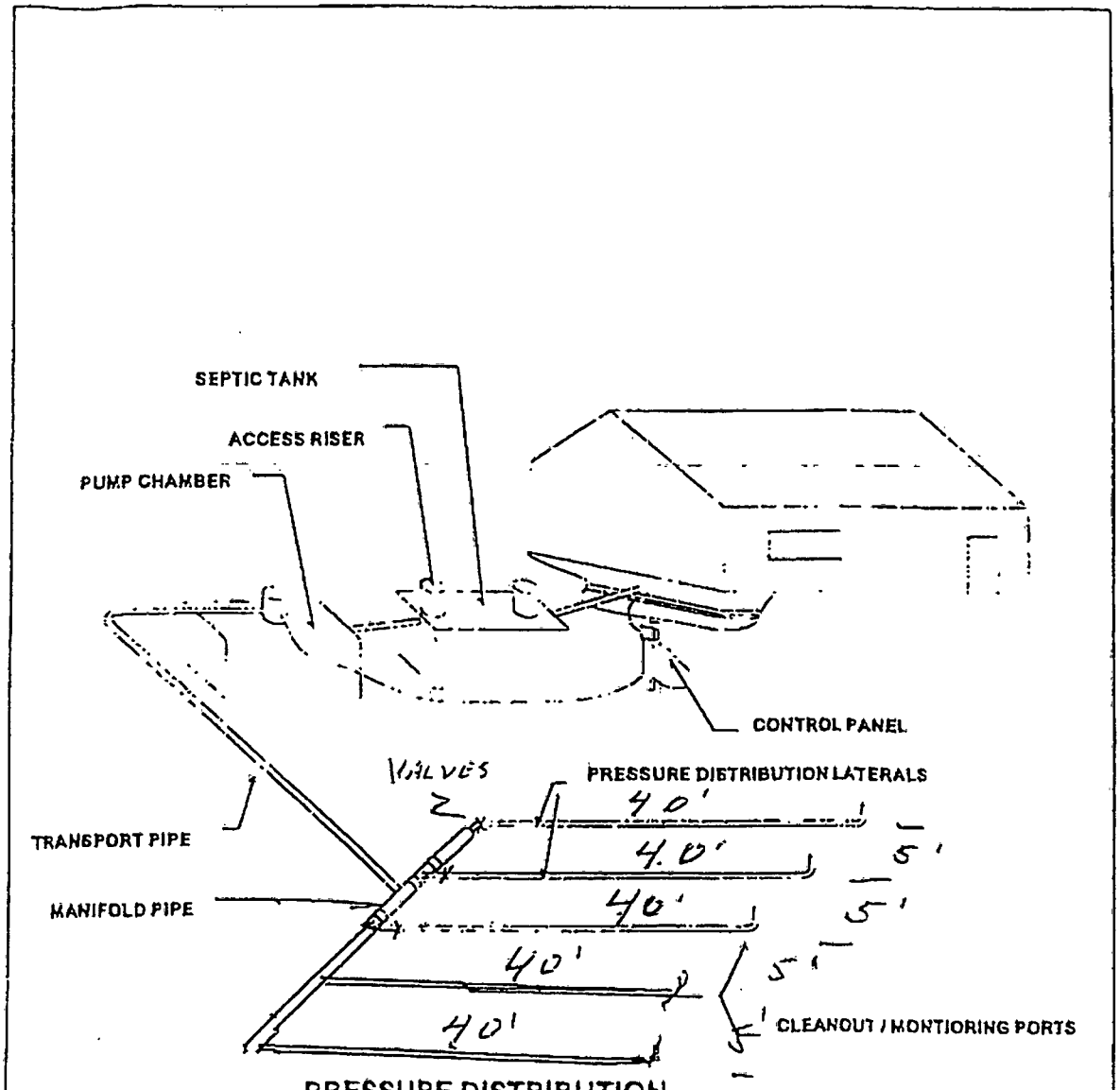
SPLITTER MANIFOLD SIDE VIEW



SPLITTER MANIFOLD TOP VIEW

Figures

Typical, Not specific for this site

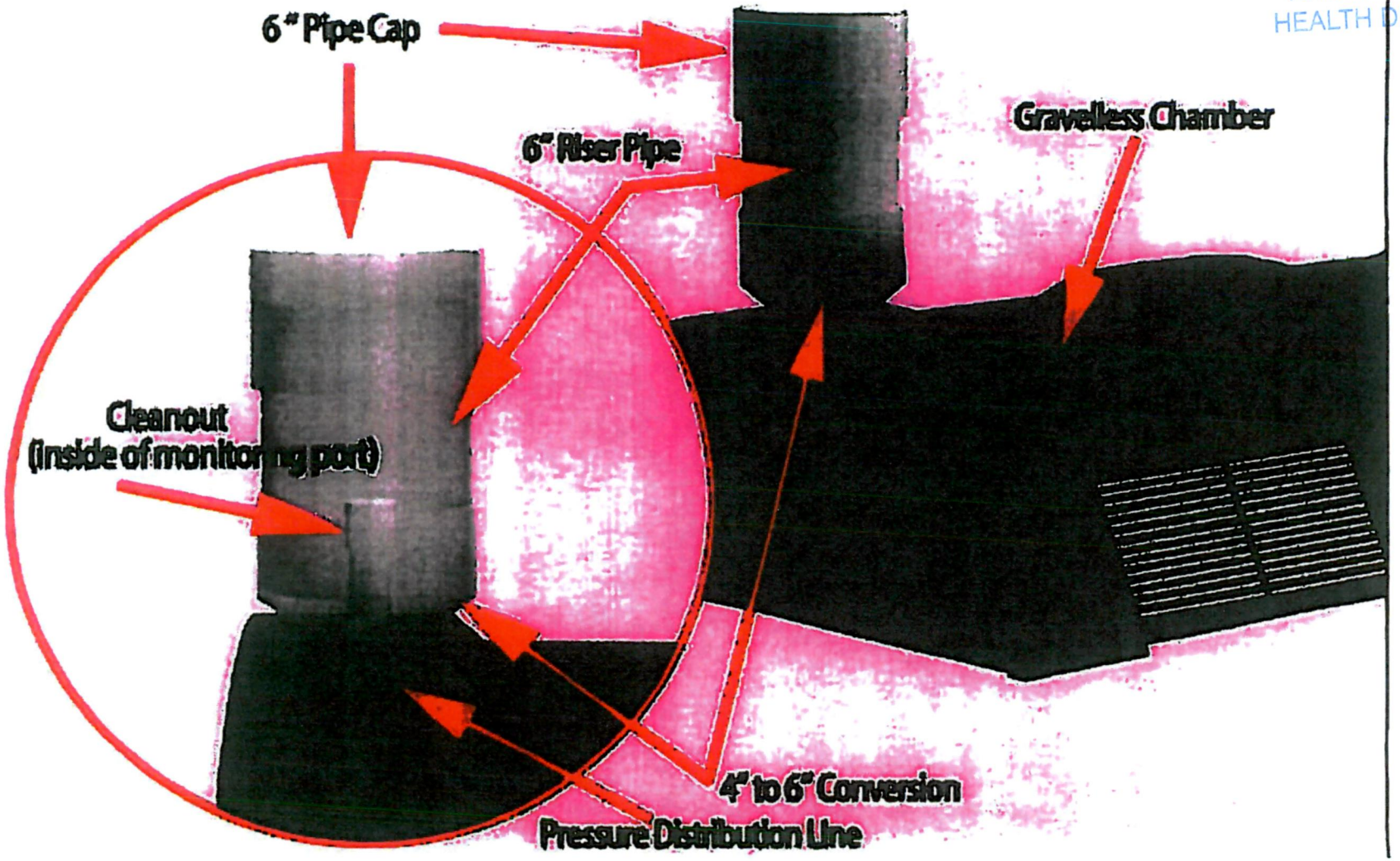


RECEIVED
NOV 16 2022
KITSAP PUBLIC
HEALTH DISTRICT

FIGURE 1

Pressure Distribution Cleanout/Monitoring Port Combo Example

RECEIVED
NOV 16 2022
KITSAP PUBLIC
HEALTH DISTRICT



***NOTE:** The Cap to the surface must be removable*

This page intentionally left blank

Allied Design Inc.
3912 Steelhead Dr NW
Bremerton, Wa 98312
(360) 620-7054

November 15, 2022

Kitsap Public Health Department

Re; Designed Sewage flow for Kitsap County North Maintenance Shop
On the corner of Bond Rd and Lamrid Rd
Tax Parcel # 062602-2-064-2007

Projected Personnel In Future Years

Road Operations

3 Supervisors
3 Mechanics
30 Staff generally gathering equipment and materials at the beginning and end of each day

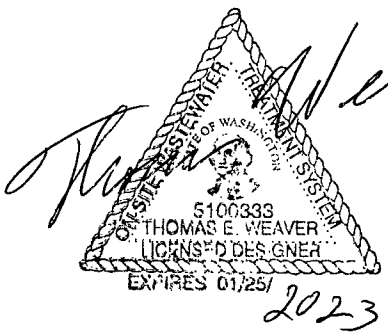
Household Hazardous Waste Collection Facility

5 Staff

This would be eleven full time on site staff and 30 at the beginning and end of each day.
Counting the 30 part time employees as five full time employees this would constitute an equivalent of 16 individuals.

16 individuals X 15 gallons per day per person would demonstrate a sewage load of 240 gpd.

Thank you;



RECEIVED
NOV 16 2022
KITSAP PUBLIC
HEALTH DISTRICT

tweaver1431@gmail.com

This page intentionally left blank

KITSAP PUBLIC
HEALTH DISTRICT

345 6th Street, Suite 300
Bremerton, WA 98337
360-728-2235

Notice of Pending Building Site Application

01/26/2023

OTAK INC
11241 Willow Rd #200
Redmond, WA 98052

Tax ID: 062602-2-064-2007
Site Address: 23026 BOND RD NE
Memo #: 129814
Water Source Type: Public
Water System Name: Unknown

Dear Applicant,

The Health District has conducted a preliminary review of your Building Site Application with respect to Kitsap County Board of Health Ordinance No. 2008A-01, Rules and Regulations Governing Onsite Sewage Systems, and has determined that the following information is needed to continue our review:

1. The proposed drainfield does not have the capacity to support the proposed use for the facilities. Please submit a redesign with an expanded drainfield and reserve drainfield.

For prompt review, please submit documentation to ossdw@kitsappublichealth.org.

Please be aware that further review of your application cannot proceed until these items are submitted to the Health District. Additional information may be requested in the future based upon continued review.

You may track the status of your application online at www.kitsappublichealth.org; click on the "Application status" button on the bottom of the page.

If you have any questions regarding this pending letter you may contact me at 360-728-2334 or christine.bronder@kitsappublichealth.org.

Thank you for your cooperation.

Sincerely,

Christine Bronder
Environmental Health Specialist
Drinking Water and Onsite Sewage Program

cc: Allied Design Inc.

23026 BOND RD NE Poulsbo

CHRONOLOGICAL CONTROL SHEET
Building Site Application - Commercial

Applicant: **OTAK INC**
Tax ID: **062602-2-064-2007**
Contractor: **Allied Design Inc.**

Memo: **129814** BP: **N/A** DCD-LU: **N/A**

RECEIVED ON	INITIALS	ACTION TAKEN/COMMENTS	ROUTE TO	DATE
11/16/2022	CF	Received OTC, no records	CB	11/16/2022
12/7/22	CB	site visit, soils as described, df ~35' to fire hydrant, site may slope slightly from north to south, clear area before install to verify shallow install on north side		
12/17/22	CB	review w/ KJ, more info is needed on water use at current facilities		
12/18/22	CB	recieved meter readings from City of Poulsbo and Bremerton, existing SHW facility is about 80 gpd, road facility varies from 225 - 1000 gpd - emailed road superintendant for more info		
1/26/23	CB	no response from county, pending redesign for larger capacity		1
4/14/23	CB	denied, see redesign memo #123027		
4/21/23	~~PJ~~	~~Denied see Redesign # 123027~~	Scan	4/21/23

- Washington State Department of Transportation, General Permit

This page intentionally left blank

Washington State Department of Transportation

General Permit

Permit No. 61454

Applicant - Please print or type all information

Application is Herby Made For: ☒ General Permit (no fee)
☐ General Permit $2.50 (Subject to RCW 47.12.140(2))

Intended Use of State Right of Way is to Construct, Operate, and Maintain a:
NKSC project will connect project stormwater closed conveyance system to the outfall end of 2 EA cross culverts that exist beneath SR 307 (Bond Road NE) (see attached Exhibit B. The connections will allow off-site, upstream stormwater runoff to continue to its historical downstream receiving area. All work will occur well outside of the travelled way, Bond Road NE roadside shoulders will be appropriately delineated with traffic cones and barrels around work zones for safety, and advanced work ahead signs will be placed appropriately. Kitsap County will be responsible for all maintenance for the added facilities.

on a portion of State Route **307** from Mile Post **2.600** to Mile Post **2.800** in **Kitsap** County,

____ 1/4 of **SW** 1/4 of Section **6** Township **26** Range **2** West/East W.M. **E**

Fees in the amount of N/A are paid to defray the basic administrative expense incident to the processing of this application according to RCW 47.12.140(2) and amendments. The applicant further promises to pay additional costs incurred by the Department on the behalf of the applicant.

***Checks or Money Orders* are to be made payable to "Washington State Department of Transportation".**

KITSAP COUNTY PUBLIC WORKS
Applicant (Referred to as Permit Holder)

23026 Bond Road NE
Address

Poulsbo **WA** **98370**
City State Zip Code

360-509-1583
Telephone

Applicant Authorized Signature

Jacques Dean
Print or Type Name

Road Superintendent
Title

Dated this 5th day of April, 2023

Authorization to Occupy Only If Approved Below

The Washington State Department of Transportation referred to as the "Department", hereby grants this Permit subject to the terms and conditions stated in the General Provisions, Special Provisions, and Exhibits attached hereto and by this reference made a part hereof: Construction facilities proposed under this application shall begin within one year and must be completed within three years from date of approval.

For Department Use Only

Exhibits Attached
Exhibit "A" – GP Specials - 6 pages
Exhibit "B" – Right-of-Way Plan - 1 sheet
Exhibit "C" – Plan Sheets - 3 sheets
Exhibit "D" – TMC Requirements - 1 sheet

Department Approval

By: **Andrew Larson, PE**

Title: **Development Services Engineer**

Date: _____

Expiration Date: **00/00/0000**

General Provisions

No changes to these General Provisions may be made without further approval of the Office of the Attorney General

DOCUMENTS, NON-EXCLUSIVE, COMPLIANCE WITH LAW, WORK

1. A copy of this Permit must be on the job site, protected from the elements, at all times during any Permit Holder activity, construction or improvement Work as authorized by this Permit. "Work" under this Permit shall include the use of WSDOT-owned right-of-way as authorized herein.
2. The Permit Holder shall be responsible for compliance with all applicable federal, state, tribal and local laws, ordinances and regulations, that affect work being performed pursuant to this Permit. The Permit Holder shall defend and indemnify WSDOT and the State of Washington against any claims that may arise because the Permit Holder (or any of its employees or subcontractors) violated a legal requirement.
3. The Permit Holder agrees that all Work shall be performed and completed to the satisfaction of WSDOT. All material and workmanship shall conform, in the sole discretion of WSDOT, to WSDOT's Standard Specifications for Road, Bridge, and Municipal Construction, current edition and amendments thereto, unless WSDOT has agreed in writing to a different standard, and shall be subject to WSDOT inspection. All WSDOT inspections of Work within WSDOT-owned highway right-of-way or upon state highway right-of-way under WSDOT jurisdiction, are solely for the benefit of WSDOT and not for the benefit of the Permit Holder, Permit Holder's contractor (if any), or any third party.
4. Upon approval of this Permit, the Permit Holder agrees to and shall diligently proceed with the Work and comply with all of the terms, provisions, and exhibits attached herein. Unless specified otherwise by WSDOT, or agreed to in writing by WSDOT, the work authorized by this Permit shall begin, be completed, or shall expire by the dates as agreed to by this Permit and its provisions, as indicated on page 1.

RIGHT OF ENTRY NON-EXCLUSIVE

5. Subject to the terms of this Permit, WSDOT hereby grants to the Permit Holder, its authorized agents, contractors, subcontractors, and employees, a right of entry upon WSDOT-owned highway right-of-way or upon state highway right-of-way under WSDOT jurisdiction, onto which access is necessary to construct, operate and/or maintain the completed Work.

   If WSDOT has approved any limited access breaks, or inner corridor access breaks, for the Work, the Permit Holder shall strictly comply with the terms and conditions of such approval.

WSDOT NOTIFICATION: SURVEY MONUMENTS, HIGHWAY SIGNS, FENCES, LANDSCAPING

6. Unless authorized by WSDOT or other affected property owner in writing, the Permit Holder shall assure that all public and private property, including but not limited to traffic signal equipment, signs, guide markers, lane markers, fences, mailboxes, guardrail, barriers, and utilities, are not impacted, damaged, destroyed, or removed. If any such property is damaged, destroyed, or removed without prior written authorization, the Permit Holder shall notify WSDOT's representative immediately of such impact, damage, destruction or removal. The Permit Holder shall replace, repair, or fully restore any private or public property that is damaged, destroyed, or removed to WSDOT's sole satisfaction.
7. The Permit Holder shall not disturb, remove, or destroy any existing Survey Monument before first obtaining a Washington State Department of Natural Resources (DNR) permit. The Permit Holder agrees that resetting Survey Monuments shall be the sole responsibility, and at the sole expense, of the Permit Holder. Such resetting of any Survey Monument shall be performed by or under the direct supervision of a Licensed Professional Land Surveyor. The Permit Holder shall notify WSDOT in writing within ten (10) calendar days of any Survey Monument that has been disturbed, removed, destroyed, or reset, and shall restore the Survey Monument to its original place and condition at the Permit Holder's sole expense within ten (10) calendar days of its disturbance, damage or destruction.

   If Permit holder does not perform the resetting work as required herein, WSDOT may perform such work and the Permit Holder agrees to fully reimburse and make payment to WSDOT within thirty (30) calendar days of the date of WSDOT's detailed invoice pursuant to Section 26 – Invoice and Payments, herein. If WSDOT chooses not to make the repairs, WSDOT may initiate an action to revoke this Permit.

   A listing of Survey Monuments can be found at the WSDOT's Geographic Services Office Website: http://www.wsdot.wa.gov/monument/searchBroad.aspx

DISTURBANCE OF EXISTING RIGHT-OF-WAY VEGETATION

8. Unless otherwise authorized by WSDOT's representative in writing prior to the start of any Work, this Permit does not authorize the Permit Holder, its' employees, contractors, or agents, any right to cut, spray, retard, remove, destroy, disfigure, or in any way modify the physical condition of any vegetative or landscaping material located on WSDOT owned highway right-of-way or upon state highway right-of-way under WSDOT jurisdiction. Should the Permit Holder anticipate that its' Work will alter the appearance of WSDOT-owned highway right-of-way vegetation or landscaping material, the Permit Holder shall notify the WSDOT representative listed in Special Provision 1 to obtain WSDOT's prior written approval of the Permit Holder's proposed Work. If WSDOT allows the Permit Holder to modify WSDOT-owned highway right-of-way vegetation, it agrees that any vegetation cutting and/or trimming activities shall be conducted in such a manner that WSDOT-owned highway right-of-way vegetation and landscaping material appearance or functionality will not be altered or damaged. Should the Permit Holder alter or damage the appearance of WSDOT-owned highway right-of-way vegetation and landscaping without WSDOT's prior written approval, the Permit Holder is subject to penalties provided for in RCW's 47.40.070, 47.40.080, and 4.24.630, as applicable.

REMOVAL OF TIMBER

9. This Permit is issued pursuant to the applicable terms of RCW 47.12.140 (Severance and Sale of Timber and other personalty - Removal of nonmarketable materials). This Permit does not authorize the Permit Holder, its' employees, contractors, or agents, any right to cut or remove any trees or timber located on WSDOT right-of-way or upon state highway right-of-way under WSDOT jurisdiction without prior written approval from WSDOT.

MERCHANDISING

10. It is unlawful for any person to build, erect, establish, operate, maintain, or conduct along and upon the right-of-way of any state highway any platform, box, stand, or any other temporary or permanent device or structure used or to be used for the purpose of receiving, vending, or delivering any milk, milk cans, vegetables, fruits, merchandise, produce, or any other thing or commodity of any nature unless a permit therefore has first been obtained from WSDOT. WSDOT shall in each instance determine where any platform, box, stand, or any other temporary or permanent device or structure shall be permitted pursuant to RCW 47.32.110.

EROSION CONTROL AND DRAINAGE

11. All discharges to WSDOT right-of-way or upon WSDOT highway right-of-way under WSDOT jurisdiction, if allowed, shall conform to State and Local water quality regulations and shall meet WAC 173-201A (Water Quality Standards for Surface Waters of the State of Washington).
12. During construction of this work, the Permit Holder shall comply with all provisions of the WSDOT Highway Runoff Manual, or WSDOT approved equivalent plan, and implement Best Management Practices (BMP's) to mitigate erosion.

CULTURAL RESOURCES

13. If any archaeological or historical resources are revealed in the Work vicinity, the Permit Holder shall immediately STOP Work, notify WSDOT's Representative and retain a United States Government Secretary of the Interior's qualified archaeologist. Said archaeologist shall evaluate the site and make recommendations to WSDOT regarding the continuance of the Work.

COMPLIANCE WITH CLEARZONE GUIDELINES

14. The Permit Holder hereby agrees that the Work described in this permit is in compliance with WSDOT's Clear Zone Guidelines pursuant to Chapter 1600 of WSDOT's Design Manual (M 22-01) and any revisions thereto. For any Work performed on a managed access state highway within an incorporated city or town, the Permit Holder may use the applicable city or towns clear zone guidelines if the city or town has their own published clear zone guidelines.

PERMIT EXTENSION AND ASSIGNMENT

15. The expiration date of this Permit may not be extended without WSDOT's prior written approval.
16. This Permit shall not be deemed or held to be an exclusive one and shall not prohibit WSDOT from granting permits or franchise rights; or entering into other agreements with other public or private companies or individuals, nor shall it prevent WSDOT from using any of its highways, streets, or public places, or affect its right to full supervision and control over all or any part of them, none of which is hereby surrendered.

MAINTENANCE DEFIENCIES

17. The Permit Holder shall correct any maintenance deficiency related to, or contributed to in any way by, the Work within thirty (30) consecutive calendar days upon receiving written notice of such deficiency from WSDOT, unless WSDOT authorizes in writing a different time period. Should the Permit Holder fail to correct a deficiency within the prescribed time period after receiving written notice of the deficiency from WSDOT, WSDOT reserves the right to perform the necessary maintenance work to preserve WSDOT right-of-way or upon state highway right-of-way under WSDOT jurisdiction or for the protection of the traveling public including bicycles or pedestrians. If WSDOT performs maintenance work as provided herein, the Permit Holder agrees to fully reimburse and make payment to WSDOT within thirty (30) calendar days of the date of WSDOT's detailed invoice pursuant to Section 26 – Invoice and Payments, herein. It WSDOT chooses not to make the repairs; WSDOT may initiate an action to revoke this Permit.

INTERFERENCE WITH OTHER PROJECTS

18. The Permit Holder agrees to schedule and perform the Work herein in such a manner as not to interfere with any WSDOT maintenance or other activities on WSDOT right-of-way or upon state highway right-of-way under WSDOT jurisdiction, including any WSDOT authorized construction activities that may be occurring in the general vicinity of the Work authorized by this Permit.

INSURANCE

19. Insurance (Applicable on a case by case basis)

    The Permit Holder shall provide proof of insurance coverage prior to performing any Work within State-owned highway right of way, as follows:

    - Commercial General Liability covering the risks of bodily injury (including death), property damage, and personal injury, including coverage for contractual liability, with a limit of not less than $5 million per occurrence and in the aggregate; OR
    - Business Automobile Liability (owned, hired, or non-owned) covering the risks of bodily injury (including death) and property damage, including coverage for contractual liability, with a limit of not less than $1 million per accident; OR
    - Employers Liability covering the risks of Permit Holder's employees' bodily injury by accident or disease, with limits of not less than $1 million per accident for bodily injury by accident and $1 million per employee for bodily injury by disease.

    WSDOT and the State shall be expressly named as an additional insureds under these general liability and automobile liability policies, by endorsing these policies with form CG2010 1185 or CA2048 (as appropriate), which shall contain no additional limitations with respect to completed operations or ongoing operations coverages, nor shall there be any limitation with respect to the negligence of WSDOT and the State. These policies shall be primary and non-contributory with respect to WSDOT and the State, and shall contain a waiver of subrogation in favor of WSDOT and the State. The Permit Holder shall furnish WSDOT proof of these insurance requirements prior to performing any Work under the Permit. A forty-five (45) calendar day written notice shall be given to the Department prior to termination of or any material change to the policy(ies) as such relate(s) to this Permit.

MODIFICATION OR REVOCATION OF THE PERMIT BY WSDOT

20a. Modification: If this Permit is modified in writing by WSDOT, the Permit Holder will have thirty (30) calendar days from the date of the written notice to modify the Work as required by WSDOT. If the modifications cannot be made within thirty (30) calendar days, the Permit Holder shall request from WSDOT, in writing, during the prescribed time period, an extension of time in which to make the modifications. Any extension of time shall be made in writing and is solely within WSDOT's discretion.

Should the Permit Holder breach any of the conditions or requirements of the permit or if WSDOT determines that emergency maintenance of the Work is required to (1) protect any aspect of the state highway right-of-way or upon state highway right-of-way under WSDOT jurisdiction, or (2) secure the safety of the traveling public due to a failure of the Permit Holder's Work or its maintenance thereof, WSDOT may perform the emergency maintenance work without the Permit Holder's prior approval, and the Permit Holder agrees to reimburse WSDOT's actual direct and related indirect costs and expenses for performing the emergency maintenance work pursuant to the provisions of Section 26 - Invoice and Payments. WSDOT will notify the Permit Holder of the emergency work performed as soon as practicable.

20b. Revocation: If the Permit is revoked and the Permit Holder fails to return the property back to its original condition, as solely determined by WSDOT, WSDOT shall perform such Work at the Permit Holder's sole cost and expense, and the Permit Holder shall reimburse WSDOT's actual direct and related indirect costs and expenses for performing the Work pursuant to the provisions of Section 27 - Invoice and Payments.

20c. Plan Corrections: WSDOT reserves the right to require changes or corrections due to plan omissions or details not in conformance with WSDOT's Standard Specifications, Standard Plans, Design Manual, or Project Special Provisions.

MODIFICATION OF THE PERMIT BY THE PERMIT HOLDER

21. If the Permit Holder desires to modify this permit and/or the Work, it shall notify the WSDOT Representative listed in Exhibit A, Special Provisions, in writing of all proposed changes for WSDOT's prior written approval. WSDOT agrees to provide written acceptance or rejection of the proposed change(s) to the Permit Holder within Ten (10) business days.

ADDITIONAL PERMIT CONDITIONS

22. The Permit Holder shall not excavate or place any obstacle within the limits of state highway right-of-way in such a manner as to interfere with WSDOT's construction, operation, and maintenance of the State Highway right-of-way or the public's travel thereon without WSDOT's prior written approval and/or as may be provided in this Permit.

23. Upon completion of all Work, the Permit Holder shall immediately remove all rubbish and debris from WSDOT right-of-way or upon state highway right-of-way under WSDOT jurisdiction, leaving WSDOT right-of- way in a neat, presentable, and safe condition, to WSDOT's sole satisfaction. Any Work-related rubbish and debris clean up, or any necessary slope treatment to restore and/or protect WSDOT right-of-way or upon state highway right-of-way under WSDOT jurisdiction, not done within seven (7) calendar days of Work completion, will be done by WSDOT at the expense of the Permit Holder, unless otherwise approved in writing by WSDOT prior to the expiration of the (7) day period.

    The Permit Holder agrees to reimburse WSDOT's actual direct and related indirect costs and expenses for performing the Work pursuant to the provisions of Section 26 - Invoice and Payments.

24. The Permit Holder agrees to maintain, at its sole expense, its Work under this Permit in a manner satisfactory to WSDOT, in WSDOT's sole discretion.

25. WSDOT shall in no way be held liable for any damage to the Permit Holder by reason of any such work by or authorized by WSDOT, its agents or representatives, or by the exercise of any rights by WSDOT upon roads, streets, public places, or structures in question.

EXTENSION OF THE EXPIRATION DATE

26. If requested by the Permit Holder, the Expiration Date of this Permit may be extended by WSDOT after review of the contributing circumstances.

INVOICE AND PAYMENTS

27. If WSDOT deems it necessary to perform Work as provided for in this Permit by WSDOT forces or its' contractor, including but not limited to any modification, repair, clean up or removal of the Work authorized under this Permit:

    a. WSDOT will assign a reimbursable account to the Permit Holder as a means of invoicing the Permit Holder for the costs associated with the Work performed by WSDOT.

    b. WSDOT will provide a detailed invoice, including direct and related indirect costs, to the Permit Holder for the Work performed by WSDOT or its contractor(s), and the Permit Holder agrees to pay WSDOT within thirty (30) calendar days of receipt of an invoice.

    c. The Permit Holder agrees that if payment is not made to WSDOT as herein agreed, WSDOT may charge late fees, interest and/or refer the debt to a Collection Agency, all in accordance with Washington State Law.

OTHER PERMITS AND APPROVALS

28. The Permit Holder shall be responsible for securing all necessary permits, including but not limited to, federal, state, and local regulatory, tribal, environmental, archeological, and railroad permits and permits from the Washington State Department of Ecology, the Washington State Department of Fish and Wildlife, and/or the U.S. Army Corps of Engineers prior to beginning the Work authorized by this Permit. The Permit Holder shall be responsible for mitigation measures where wetlands have been disturbed and agrees that it is solely responsible for any fines imposed for noncompliance with the permit(s) conditions or for failure to obtain the required permits. In addition, the Permit Holder, on behalf of itself and its contractors, officers, officials, employees, and agents, agrees to indemnify, hold harmless, and defend, at its sole cost and expense, WSDOT and its officers, officials, employees, and agents from any and all fines, costs, claims, judgments, and/or awards of damages to regulatory agencies, persons, and/or property, arising out of, or in any way resulting from, the Permit Holder's failure to (1) obtain any required permit for the Permit Holder Work or (2) comply with permit conditions.

INDEMNIFICATION, WAIVER, VENUE, AND ATTORNEYS FEES

29. The Permit Holder, its successors and assigns, shall indemnify, defend at its sole cost and expense, and hold harmless the State of Washington, its officers, employees, and agents from all claims, suits, demands, actions for damages (both to persons and/or property), expenses, regulatory fines, and/or suits in law and in equity that (1) arise out of or are incident to, or alleged to arise out of or are incident to, any acts or omissions of the Permit Holder, its agents, contractors, subcontractors, employees, invitees, successors, assigns and/or any other person in the use of the WSDOT-owned highway right-of-way or upon state highway right-of-way under WSDOT jurisdiction as authorized by the terms and conditions of this Permit, or (2) are caused by the breach of any of the terms or conditions of this Permit by the Permit Holder, its successors and assigns, and its contractors, subcontractors, agents, employees, invitees and/or any other person. The Permit Holder, its successors and assigns, shall not be required to indemnify, defend, or hold harmless the State of Washington, its' officers, employees and/or agents, if the claim, suit, or action for damages (both to persons and/or property) is caused by the sole acts or omissions of the State of Washington, its' officers, employees and/or agents; provided that, if such claims, suits, or actions result from the concurrent negligence of (1) the State of Washington, its officers, employees and/or agents, and (2) the Permit Holder, its agents, contractors, subcontractors, employees, invitees, successors, assigns and/or any other person or involves those actions covered by RCW 4.24.115, the indemnity provisions provided herein shall be valid and enforceable only to the extent of the acts or omissions of the Permit Holder, its agents, contractors, subcontractors, employees, invitees, successors, assigns and/or any other person.

30. The Permit Holder agrees that its obligations under this Permit extend to any claim, demand, and/or cause of action brought by, or on behalf of, any of its' employees or agents while performing Work under this Permit while located on or off WSDOT-owned highway right of way or upon state highway right of way under WSDOT jurisdiction. For this purpose, the Permit Holder, by mututal negotiation, hereby waives, with respect to the State of Washington only, any immunity that would otherwise be available to it against such claims under the Industrial Insurance provisions in chapter 51.12 RCW.

31. The indemnification and waiver provided for in Sections 29 and 30 shall survive the termination of this Permit.

32. In the event that the Permit Holder or WSDOT deems it necessary to institute legal action or proceedings to enforce any right or obligation under this Permit, the Permit Holder and WSDOT agree that any such action or proceedings shall be brought in the superior court situated in Thurston County, Washington. Further, the Permit Holder agrees that it shall be solely responsible for its own attorney's fees and costs and agrees that it shall not seek nor be entitled to recovery of such attorney's fees and costs.

NONAPPLICABILITY OF RELOCATION ASSISTANCE/EMINENT DOMAIN

33. The Permit Holder acknowledges that this Permit does not at any time entitle the Permit Holder, its successors or assigns, to assistance under the Relocation Assistance - Real Property Acquisition Policy (Chapter 8.26 RCW). Further, the revocation or other termination of this Permit shall not be deemed a taking by WSDOT under the laws of eminent domain.

EXHIBIT "A"

This page intentionally left blank

Washington State Department of Transportation

Special Provisions

These Special Provisions, in no way, relieve the responsibility of the Permit Holder or their authorized agents, contractor's, subcontractor's and employees (hereinafter called the Permit Holder) to meet the requirements of, but not limited to, WSDOT Standard Specifications and Standard Plans.

Applicable provisions are denoted by (☑)

☑ **1. WSDOT REPRESENTATIVE** ***(Applicable to All Projects)***

No Work under this Permit shall be performed until the PERMIT HOLDER is authorized in writing by letter or by email to begin Work, by the following WSDOT Representative:

NAME: Duke Stryker and Jeff Smiley

TITLE: Area 2 Maintenance Superintendent and Assistant Superintendents

ADDRESS: 8293 SE Spring Creek Road

CITY: Port Orchard

STATE: WA ZIP CODE: 98367

PHONE: 360-874-3051 CELL:

EMAIL: Stryked@wsdot.wa.gov, and SmileyJ@wsdot.wa.gov

☑ **2. PRE-CONSTRUCTION CONFERENCE.** *(Applicable to ALL Projects)*

Prior to the beginning of construction, a Pre-Construction Conference shall be held at which WSDOT Representative, the Permit Holder Representative(s), and Permit Holder's contractor shall be present.

☐ **3. INSPECTION.** *(Applicable to ALL Projects)*

Upon completion of work, the Permit Holder shall request a Preliminary Final Inspection for Conditional Acceptance and Conditional Approval by WSDOT.

☐ **4. UNSUITABLE MATERIALS.** *(Applicable to ALL Projects)*

If determined necessary by WSDOT, unsuitable, hazardous, or contaminated materials encountered during any excavation shall be removed and replaced to the satisfaction of WSDOT at the Permit Holder 's expense. The replacement material shall be free-draining and granular, or other materials as determined by WSDOT's Construction Representative in accordance with the Standard Specifications.

☐ **5. LANDSCAPING ON STATE RIGHT-OF-WAY** *(Applicable to Counties and Limited Access in All Cities)*

- **PLANTINGS.**
  If the Permit Holder desires to plant and/or cultivate any shrubs, trees, hedges, or other domestic or native ornamental growth on WSDOT owned highway right-of-way that is more extensive than regular WSDOT vegetation, the Permit Holder shall obtain a Roadside Vegetation Permit (DOT Form 220-018) from WSDOT for the maintenance of the plantings.
- **IRRIGATION SYSTEMS.**
  If the Permit Holder desires to install an irrigation system, the Permit Holder may be required to obtain additional approval. The Permit Holder shall be responsible for water and electrical costs.

☐ **6.TRAFFIC CONTROL PLAN** *(Applicable to all City Projects within Limited Access Areas and/or City Projects within Managed Access Areas involving WSDOT maintained Traffic Signals, Freeway Ramps, or Ferry Traffic. Applicable to all other City Projects when WSDOT assistance is requested by the City. Applicable to all County Projects)*

Prior to construction and/or maintenance of this facility, the Permit Holder shall submit Traffic Control Plans to WSDOT for Review and Approval at least ten (10) days in advance of the time that signing and other traffic control devices will be required. These TCP's shall be in compliance with The Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways – Part 6 (Temporary Traffic Control) https://mutcd.fhwa.dot.gov/pdfs/2009r1r2/part6.pdf and Washington modifications thereto. All TCP's shall be site specific, unless allowed otherwise by WSDOT.

The primary function of work zone traffic control is to allow vehicles, cyclists, and pedestrians to move safely and easily through or around work areas while still allowing for safe and efficient work operations to be conducted. Effective temporary traffic control enhances traffic safety and efficiency. Drivers and pedestrians need to be guided in a clear and positive manner while approaching and navigating temporary traffic control zones.

- **MODIFICATION, REVOCATION, OR SUSPENSION OF APPROVED TRAFFIC CONTROL PLANS**
  WSDOT reserves the right to modify or revoke any Traffic Control Plan at any time due to unexpected emergencies or safety and operational problems for the traveling public. All costs and time delays associated with modification or revocation shall be borne by the Permit Holder. WSDOT shall in no way be held liable for any delays, costs, or other damages to the Permit Holder by reason of any such WSDOT action.
- **PERMITTED HOURS FOR LANE CLOSURES / WSDOT NOTIFICATION**
  The working hours within WSDOT owned highway right-of-way or highway right-of-way under WSDOT jurisdiction for this project are restricted per the Approved Traffic Control Plan(s). Any extension of these hours must be requested in writing and approved prior to construction. Weekend or Holiday (including Canadian Holidays-Skagit & Whatcom Counties) work is not permitted without written permission from WSDOT. Five (5) working days notification shall be given to WSDOT's Representative prior to any lane closure.
- **HAZARD PROTECTION**
  All hazards to vehicular, pedestrian, and bicycle traffic shall be marked by warning signs, barricades, and lights.
- **STORAGE OF EQUIPMENT AND MATERIALS**
  All lanes shall be open and the shoulders shall be clear of construction equipment and materials during non-working hours. The Work Zone Clear Zone (WZCZ) applies during working and non-working hours. The WZCZ applies only to temporary roadside objects introduced by the Contractor's operations and does not apply to pre-existing conditions or permanent work. Those work operations that are actively in progress shall be in accordance with adopted and approved Traffic Control Plans, and other Contract or Permit requirements.

  During nonworking hours, equipment or materials shall not be within the WZCZ unless they are protected by permanent guardrail or temporary concrete barrier. The use of temporary concrete barrier shall be permitted only if WSDOT approves the installation and location.

  During actual hours of work, unless protected as described above, only materials absolutely necessary to construction shall be within the WZCZ and only construction vehicles absolutely necessary to construction shall be allowed within the WZCZ or allowed to stop or park on the shoulder of the roadway.

  The Contractor's non-essential vehicles and employee's private vehicles shall not be permitted to park within the WZCZ at any time unless protected as described above.

  Deviation from the above requirements shall not occur unless the Contractor has requested the deviation in writing, and WSDOT has provided written approval.

☑ **7. WORKER VISIBILITY** *(Applicable to Counties and Limited Access in All Cities)*

- **FLAGGER APPAREL**
  Traffic Control Supervisors, Flaggers, Spotters, and others performing Traffic Control Labor of any kind shall comply with the following: (1) During daylight hours with clear visibility, workers shall wear a high-visibility ANSI/ ISEA 107-2010 Class 2 or 3 vest or jacket, and hardhat meeting the high-visibility headwear requirements of WAC 296-155-305; and (2) During hours of darkness (½ hour before sunset to ½ hour after sunrise) or other low visibility conditions (snow, rain, fog, etc.), workers shall wear a high-visibility ANSI/ISEA 107-2010 Class 2 or 3 vest or jacket, high-visibility lower garment meeting ANSI/ISEA 107-2010 Class E, and hardhat meeting the high-visibility headwear requirements of WAC 296-155-305.
- **APPAREL - OTHER CONTRACTOR PERSONNEL**
  The Permit Holder and/or the Contractor shall require all other personnel in WSDOT owned highway right-of-way or highway right-of-way under WSDOT jurisdiction under their control (including Service Providers, Subcontractors, and lower tier Subcontractors) that are on foot in the work zone and are exposed to vehicle traffic or construction equipment to wear the high-visibility apparel meeting Performance Class 2 or 3 requirements of the ANSI/ISEA 107-2010 publication titled "American National Standard for High Visibility Safety Apparel and Headwear."

☐ **8. DIRECTIONAL BORING OPERATIONS** *(Applicable to Counties and Limited Access in All Cities)*

- To prevent loss of ground and settlement, or possible damage to overlying structures, pipe installation operations shall be conducted in such a manner that restricts the excavation of materials to only those materials that are physically displaced by the casing. The Permit Holder shall control the advance rate, monitor the volume of material excavated and adjust the advance rate, as required, to avoid loss of ground, over excavation, and surface heave.
- During the bore, the Permit Holder shall monitor and calculate the volume of the spoils quantities removed, taking in consideration the swelling factor for the material. This will be measured against the calculated volume of the casing to ensure over-excavation has not occurred.
- If caving or sloughing occurs the Permit Holder shall modify the construction method to prevent further sloughing or caving. The soil shall be stabilized and the void outside the pipe in the area of the caving shall be filled with grout or other approved material.

- The pipes shall be installed without damage to traveled lanes and shoulders, or other facilities above the pipe. Damage to existing facilities as a result of the Permit Holder's operations shall be repaired to the satisfaction of WSDOT at the Permit Holder's expense. The repair procedure shall be proposed by the Permit Holder and approved by WSDOT.
- Removal of material from the pipe by washing or sluicing will not be permitted.
- All concrete, steel, lumber, and other manmade materials shall be removed from the insertion and receiving pits. The pit backfill shall restore contours to the pre-existing condition.

☐ **9. CRANE BOOM WITHIN WSDOT RIGHT-OF-WAY.** *(Applicable to Counties and Limited Access in All Cities)*

This Permit provides the Permit Holder temporary use of WSDOT's airspace right of way; no permission is granted for use of WSDOT's right of way at the ground level.

Unloaded crane swings, including "weather vaning" will be permitted as shown in the Exhibits.

Crane load swings within thirty (30) feet of the paved edge of WSDOT highway right-of-way or ramps are prohibited and will be cause for immediate revocation of Permit.

No use other than operating or "weather vaning" one (1) construction tower-crane booms within WSDOT's airspace right of way is permitted without the prior written approval from WSDOT.

Signs, display lights, or advertising media/materials are not permitted unless they comply with Chapter 47.42 RCW and Chapter 468-66 WAC and are completely detailed on a separate plan sheet which requires specific prior written authorization by WSDOT. Advertising signs or banners shall not be allowed on any portion or parts of the cranes operating within WSDOT right-of-way.

☐ **10. CRANE OPERATIONS WITHIN WSDOT RIGHT OF WAY.** *(Applicable to Counties and Limited Access in All Cities)*

The Permit Holder shall:

- Comply with all applicable federal, state and local laws, ordinances, and regulations, including environmental requirements that are in force or which may hereafter be in force. The Permit Holder shall also secure all necessary permits and licenses for the use of WSDOT's right of way authorized by this Permit.
- Provide WSDOT with a crane safety and operations plan for approval and receive safety and operations plan approval from WSDOT prior to operating any crane within WSDOT's right-of-way. The plan shall:
  1) List how the Permit Holder will comply with applicable state and federal laws.
  2) Ensure that crane operators will not swing loads within thirty (30) feet of the paved edge of WSDOT highway or ramps.
  3) Designate the individual responsible to oversee and perform Permit Holder's crane operations and safety measures.
  4) Provide names and telephone contact numbers affording 24-hour, 7-day-a-week contact.
  5) Show any suitable crane "limit" switches installed and provide specific details describing how the Permit Holder will ensure compliance with the safety and operations plan.

The plan shall be submitted to WSDOT's Representative for written approval prior to the start of any Crane Operations. The plan shall:

- Designate a signal person and a safety officer to oversee crane operations. The officer, signal person or any construction person on-site shall have authority to stop the operation of the crane if a load appears that it will swing any closer than thirty (30) feet from the paved edge of WSDOT highway or ramps.
- Require a daily pre-lift meeting by the crane operator, signal person, and designated safety officer to discuss their operating plan prior to commencing daily crane operations.
- Ensure that the signal person shall remain in continuous sight of, or in direct communication with, the crane operator in accordance with WAC 296-155-5245.
- Provide a crane operations safety training program for all employees who will access the Permit Holder's construction site.
- Secure access to the project site to prevent unauthorized entry during non-operating hours and take steps to prevent unauthorized crane operation during non-operating hours, such as locking/disabling the crane operator's controls and disconnecting electrical power to the crane.
- Post emergency or after-hour contact telephone numbers on a WSDOT approved sign attached to State Highway right-of-way fence and a sign at the entrance to Permit Holder's construction site.
- Provide evidence of crane inspection certified by state/federal regulators as applicable.
- Ensure a minimum vertical crane boom clearance of eighty (80) feet as measured from the highest point of the roadway finished grade to the lowest point on the boom arm.

☐ **11. REMOVAL OF MONITORING WELLS.** *(Applicable to Counties and Limited Access in All Cities)*

In accordance with the timeline stated in WAC 173-160-151 the Permit Holder shall notify WSDOT Representative in writing at least five (5) days prior to the removal of any Wells to allow WSDOT staff to monitor and review said removal. The Permit Holder shall remove the Wells at its expense in accordance with WAC 173-160 and any amendments thereto.

Further, upon termination of this Permit under any provision hereof, the improvements constructed by the Permit Holder on the premises shall be removed by the Permit Holder at Permit Holder's expense in accordance to WAC 173-160 and the Permit Holder shall restore the premises to the original condition prior to Permit Holder's operations.

☐ **12. ADVERTISING SIGNS.** *(Applicable to Counties and Limited Access in All Cities)*

Any advertising adjacent to state highways must be in compliance with the Scenic Vistas Act of 1971, Chapter 47.42 RCW and Chapter 468-66 WAC. Violation of this section of the statutes will be sufficient cause for cancellation of this Permit. Advertising signs are allowed off State Highway right-of-way, subject to Local Codes and Regulations.

☐ **13. AS-BUILT CONSTRUCTION PLANS** *(Applicable on a case by case basis)*

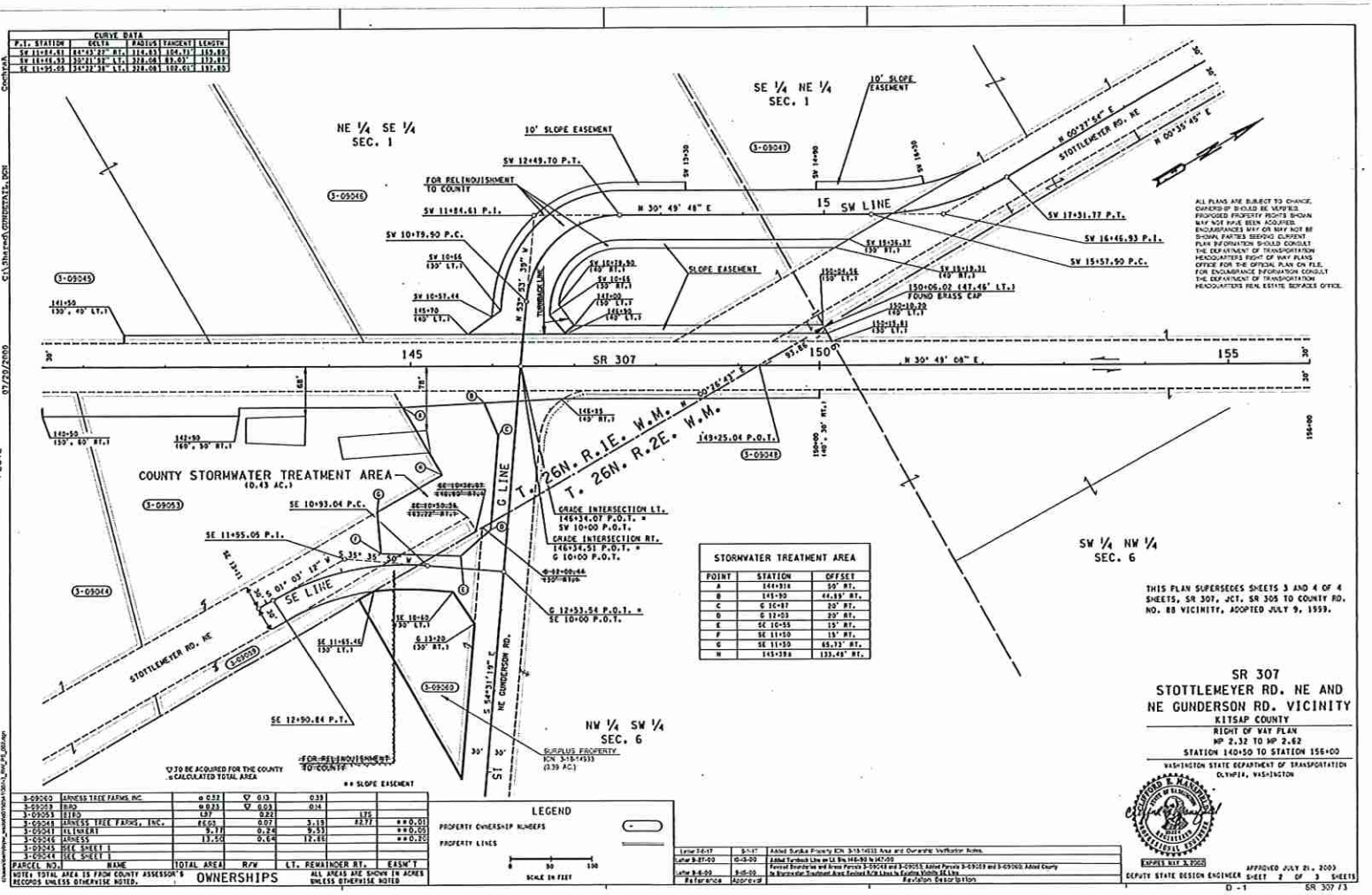
The Permit Holder shall provide WSDOT representative(s), listed in Special Provision (1), with detailed as-built drawings within ninety (90) calendar days of Work completion, if the originally approved Permit construction plans have been revised during the course of construction or if WSDOT requires modifications.

☐ **14. FINAL INSPECTION** *(Applicable on a case by case basis)*

Upon completion of the Work, as proposed in Exhibit X - Plans, the Permit Holder shall notify WSDOT's representative, listed in Special Provision (1), in writing within ten (10) calendar days to obtain WSDOT's final inspection of the Work. Should WSDOT require any changes to the Work, Permit Holder agrees to make such modification as WSDOT deems necessary, in its sole discretion. Permit Holder shall make all such modifications at its sole cost and expense.

EXHIBIT "B"

This page intentionally left blank



CURVE DATA				
P.I. STATION	DELTA	RADIUS	TANGENT	LENGTH
SE 11+84.61	84°43'22" RT.	116.83	104.72	155.88
SW 11+46.93	30°21'36" LT.	328.08	88.83	173.81
SE 11+55.05	34°27'38" LT.	328.08	102.01	197.03

OWNERSHIPS						
PARCEL NO.	NAME	TOTAL AREA	R/W	LT. REMAINDER RT.		EASM'T
3-09060	KINGSS TREE FARMS, INC.	± 0.52	▽ 0.13	0.39		
3-09059	BLIND	± 0.23	▽ 0.03	0.14		
3-09055	BLIND	1.37	0.22		1.15	
3-09049	KINGSS TREE FARMS, INC.	±5.03	0.07	3.15	1.27	**±0.01
3-09047	ELLINGERT	9.77	0.24	9.53		**±0.00
3-09046	KINGSS	13.50	0.64	12.86		**±0.20
3-09045	SEE SHEET 1					
3-09044	SEE SHEET 1					

NOTE: TOTAL AREA IS FROM COUNTY ASSESSOR'S RECORDS UNLESS OTHERWISE NOTED.
ALL AREAS ARE SHOWN IN ACRES UNLESS OTHERWISE NOTED

LEGEND
PROPERTY OWNERSHIP NUMBERS
PROPERTY LINES
0 50 100
SCALE IN FEET

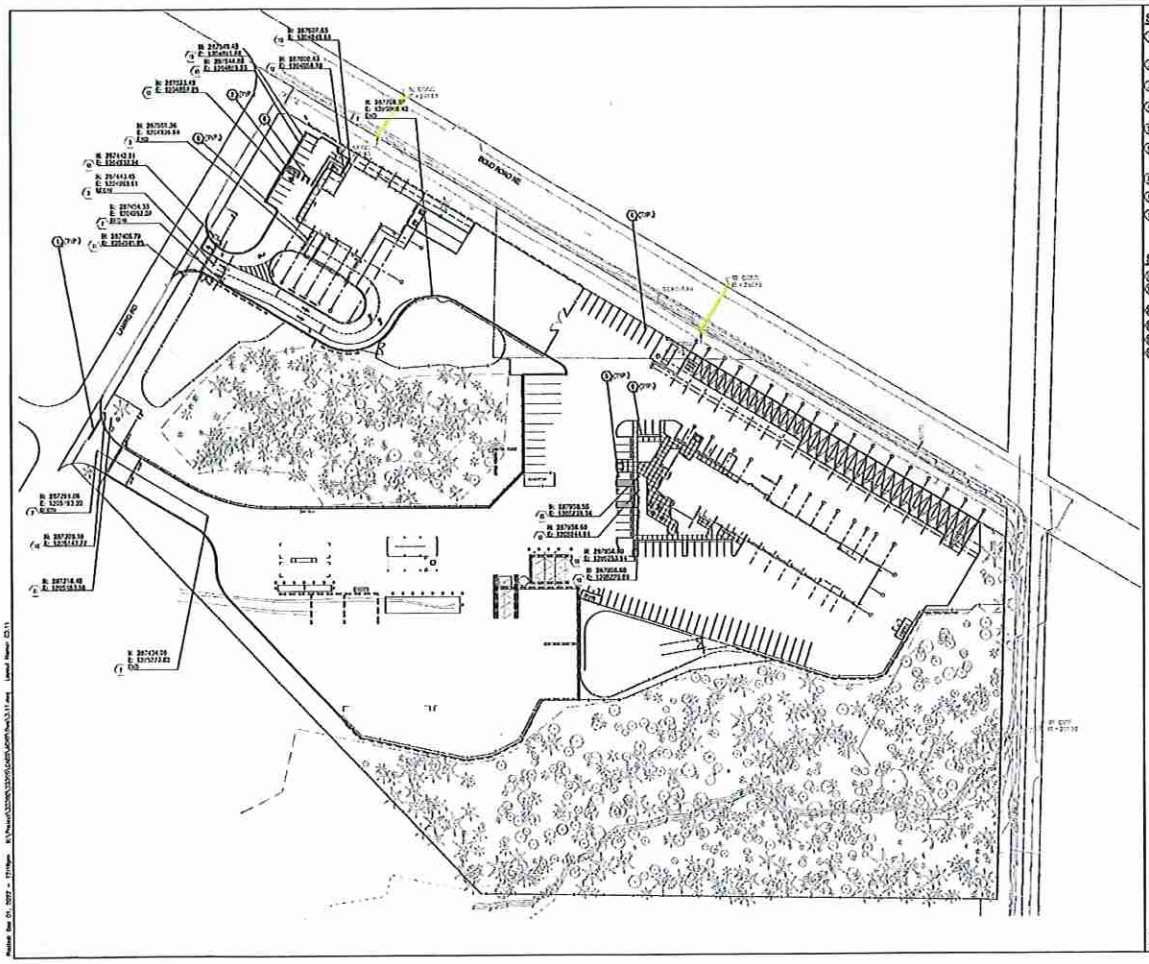
Revision Description		
Letter 7-8-17	5-1-17	Added Surplus Property ION 3-13-14533 Area and Ownership Verification Notes.
Letter 9-27-00	0-0-00	Added Turnback Line on Lt. Sta. 145+50 to 147+00
Letter 9-8-00	9-15-00	Removal Shoreline and Area Parcels 3-09045 and 3-09055; Added Parcels 3-09059 and 3-09060; Added County Stormwater Treatment Area; Revised R/W Lines to Existing Vicinity Of Line
Reference	Approved	

* TO BE ACQUIRED FOR THE COUNTY
± CALCULATED TOTAL AREA
** SLOPE EASEMENT

This page intentionally left blank

EXHIBIT "C"

This page intentionally left blank



STRIPING NOTES

1. INSTALL 8" WIDE THERMOPLASTIC STOP BAR PER KITSAP COUNTY DEPT. OF PUBLIC WORKS STD DETAIL FIG. 5-2.
2. INSTALL SOLID WHITE 4 IN WIDE STRIPE AT 45 DEGREE ANGLE.
3. INSTALL 4 IN WIDE WHITE GAP STRIPE PER WSDOT STD PLAN M-20.10-04.
4. INSTALL 4 IN WIDE SOLID WHITE PARKING STRIPE PER WSDOT STD PLAN M-20.10-04.
5. INSTALL ADA PARKING SPACE PER DETAIL ON SHEET C3.12.
6. INSTALL THERMOPLASTIC CROSSWALK MARKING PER KITSAP COUNTY DEPT. OF PUBLIC WORKS STD DETAIL FIG 5-2.
7. INSTALL 8 IN WIDE THERMOPLASTIC LANE LINE PER WSDOT STD PLAN M-20.10-04.
8. INSTALL THERMOPLASTIC ARROW PER WSDOT STD PLAN M-24.60-02.
9. INSTALL WHITE STOP PER DETAIL 2 ON SHEET C3.12.

SIGNING NOTES

10. INSTALL STOP SIGN (R1-1)
11. INSTALL ONEWAY SIGN PER DETAIL 4 ON SHEET C3.11.
12. INSTALL ADA PARKING SIGN (R7-8D).
13. INSTALL VAN PARKING ONLY SIGN.
14. INSTALL DO NOT ENTER SIGNS SIGN.
15. INSTALL VAN ACCESSIBLE PARKING SIGN (R7-8A)

KEY MAP

SCALE: 1" = 30'

CALL BEFORE YOU DIG 1-800-424-5555

PRELIMINARY - NOT FOR CONSTRUCTION

Otak

113072

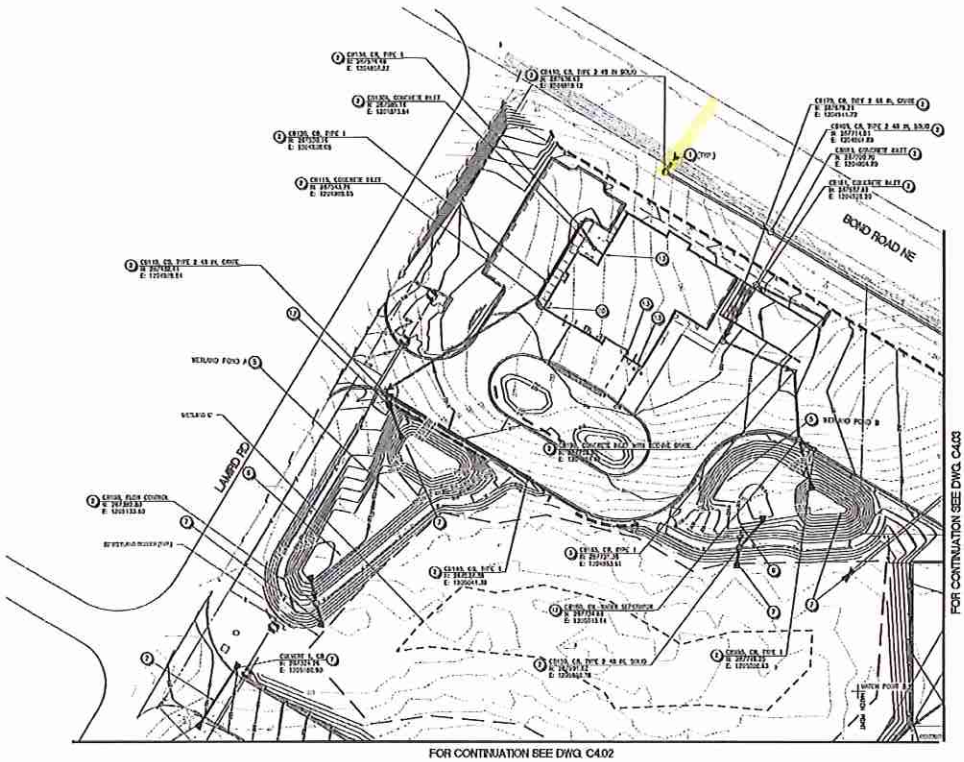
North Kitsap Service Center

NORTH KITSAP SERVICE CENTER

23626 BOND RD NE
POULSBO, WA 98370

SIGNAGE AND STRIPING PLAN

C3.11

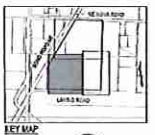


GRADING AND DRAINAGE NOTES

1. CONNECT TO EXISTING STORM DRAINAGE SYSTEM.
2. INSTALL DRAINAGE STRUCTURE, TYPE AND SIZE AS SHOWN.
3. INSTALL RESTORATION WALL, SEE SHEET C4.53 FOR DETAILS.
4. INSTALL RETENTION WALL, SEE C4.51 FOR DETAILS.
5. CONSTRUCT STORMWATER PLANTER, SEE ////// AND C4.51 FOR DETAILS.
6. INSTALL PIPE INLET PROTECTION PER DETAIL ON SHEET C4.54.
7. INSTALL PIPE OUTLET PROTECTION PER DETAIL ON SHEET C4.54.
8. INSTALL HYDRODYNAMIC SEPARATOR, SEE SHEET C4.53 FOR DETAILS.
9. INSTALL OIL SEPARATOR, SEE SHEET C4.53 FOR DETAILS.
10. INSTALL ROOF DRAIN COLLECTION PER DETAIL 2 ON SHEET C4.50. SEE PLUMBING PLANS FOR CONTINUATION.
11. INSTALL FLOW CONTROL STRUCTURE PER DETAIL ON SHEET C4.52.
12. INSTALL OIL-WATER SEPARATOR PER DETAIL ON SHEET C4.52.
13. INSTALL FOUNDATION DRAIN CONNECTION. SEE PLUMBING PLANS.

GENERAL NOTES

1. [illegible]
2. CONTRACTOR TO INSTALL UNDERGROUND FOUNDATION DRAIN, ROOF DRAINS, AND WALL DRAINS SO THEY DO NOT CONFLICT WITH FOOTINGS AND OTHER UNDERGROUND UTILITIES. CONTRACTOR TO COORDINATE AS NECESSARY TO ENSURE A FULLY OPERATIONAL SYSTEM.
3. SEE DETAIL 3 ON SHEET C4.50 FOR STRUCTURE PLACEMENT DETAILS.



KEY MAP

SCALE: 30 0 30 60 IN FEET

CALL BEFORE YOU DIG 1-800-424-5555

PRELIMINARY - NOT FOR CONSTRUCTION

Otak

11/30/22

North Kitsap Service Center

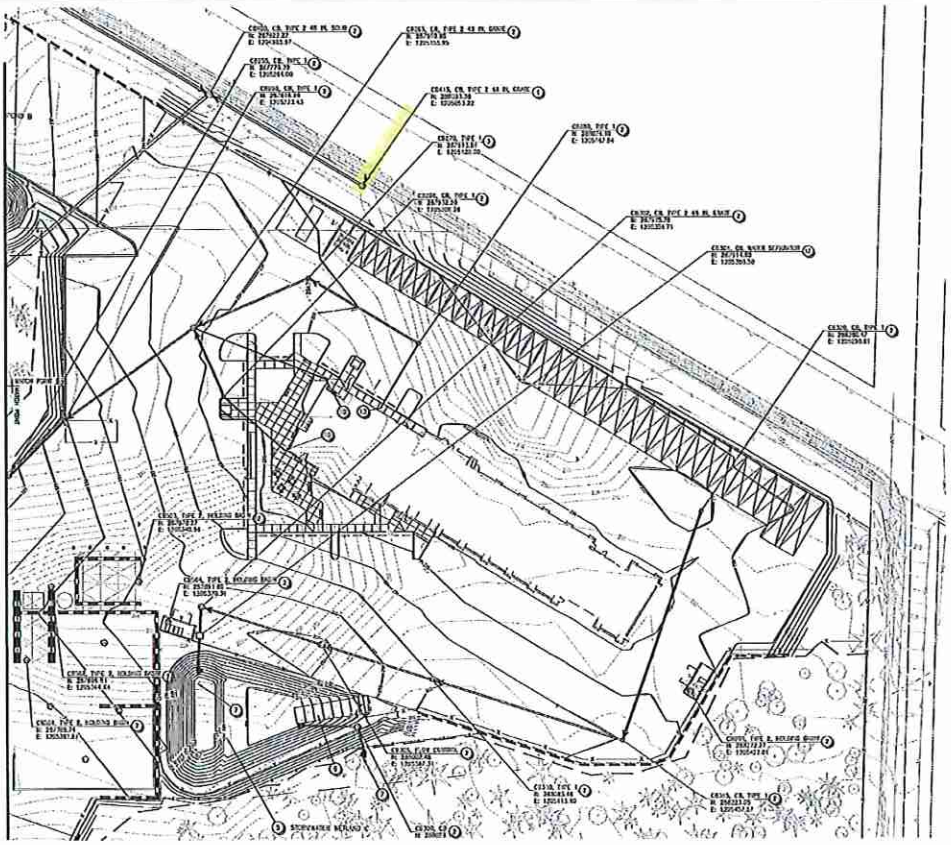
NORTH KITSAP SERVICE CENTER

23025 BOND RD NE
POULSBO, WA 98370

DRAINAGE PLAN

#	DATE	DESCRIPTION

C4.01



GRADING AND DRAINAGE NOTES

1. CONNECT TO EXISTING STORM DRAINAGE SYSTEM.
2. INSTALL DRAINAGE STRUCTURE, TYPE AND SIZE AS SHOWN.
3. INSTALL DEFLECTION VALVE, SEE SHEET C4.53 FOR DETAILS.
4. INSTALL DETENTION VAULT, SEE C4.51 FOR DETAILS.
5. CONSTRUCT STORMWATER MEASURE, SEE ///// AND C4.51 FOR DETAILS.
6. INSTALL PIPE INLET PROTECTION PER DETAIL ON SHEET C4.50.
7. INSTALL PIPE OUTLET PROTECTION PER DETAIL ON SHEET C4.50.
8. INSTALL HYDROCARBON SEPARATOR, SEE SHEET C4.51 FOR DETAILS.
9. INSTALL OIL SEPARATOR, SEE SHEET C4.52 FOR DETAILS.
10. INSTALL ROOF DRAIN CONNECTION PER DETAIL 2 ON SHEET C4.50. SEE PLUMBING PLANS FOR CONTINUATION.
11. INSTALL FLOW CONTROL STRUCTURE PER DETAIL ON SHEET C4.50.
12. INSTALL OIL-WATER SEPARATOR PER DETAIL ON SHEET C4.52.
13. INSTALL FOUNDATION DRAIN CONNECTION. SEE PLUMBING PLANS.

GENERAL NOTES

1. [illegible]
2. CONTRACTOR TO INSTALL UNDERGROUND, FOUNDATION DRAINS, ROOF DRAINS, AND SIDE DRAINS SO THEY DO NOT CONFLICT WITH FOUNDATIONS AND OTHER UNDERGROUND UTILITIES. CONTRACTOR TO COORDINATE AS NECESSARY TO PROVIDE A FULLY OPERATIONAL SYSTEM.
3. SEE DETAIL 1 ON SHEET C4.50 FOR STRUCTURE PLACEMENT DETAILS.

SCALE 30 0' 30 60 IN FEET

CALL BEFORE YOU DIG 1-800-424-5555

PRELIMINARY - NOT FOR CONSTRUCTION

Otak

11/30/22

11/30/22

North Kitsap Service Center

NORTH KITSAP SERVICE CENTER

23C20 BOND RD NE
POULSBO, WA 98370

DRAINAGE PLAN

C4.03

This page intentionally left blank

EXHIBIT "D"

This page intentionally left blank

Olympic Region Traffic Management Center (TMC) Requirements

The Olympic Region Traffic Management Center (TMC) is the central resource for tracking highway traffic activity reporting relative to all maintenance, construction, and other highway work activities that are or will be occurring in the Region. The TMC is staffed 24 hours a day seven days a week. Traffic impact activities to be called in and reported by the permit holder include, but are not limited to, the following:

- Any lane closure on a state highway.
- Any shoulder closure on a state highway in the more urban higher traffic volume areas.
- Any work activity of any kind on a state highway limited access freeway.
- Any work activity that may or does cause traffic delays or other distractions to the traveling public on a state highway.

The permit holder shall call the TMC at (253) 538-3300 each time a possible traffic impact activity is about to commence or occurs. The permit holder shall call the TMC 30 minutes in advance of the activity commencing, during the activity if conditions arose that initially did not require the call-in, and at the conclusion of any activity that was reported. Information that shall be provided to the TMC each time an activity begins shall include the following:

- Name of caller,
- State Route (SR) number,
- SR milepost if known, or other description adequately describing the location of the activity (e.g. nearest intersection),
- Brief description of the activity that is about to start,
- The expected duration of the activity that is about to occur,
- Permit number allowing the work,
- Contact names and phone number(s) that allow for direct communication between the TMC and the person(s) onsite that is/are in charge of the activity that is occurring.

Please note the TMC number listed above is to be used for official state business only, and is not a public number to be used for inquires or other reporting of activities on the state highway system. Call 911 for emergencies, or other activities such as reporting a disabled vehicle on the shoulder.

This page intentionally left blank

- Kitsap County Department of Community Development,
  Site Development Activity Permit (SDAP) 22-03979 Plan Acceptance

This page intentionally left blank

Kitsap County Department of Community Development

April 28, 2023

Jacques Dean, Project
Kitsap County Public Works
614 Division ST, MS 26
Port Orchard, WA 98366

RE **N**orth **K**itsap **S**ervice **C**enter
Site **D**evelopment **A**ctivity **P**ermit **(SDAP) 22-03979**
PLAN ACCEPTANCE

We have reviewed and accept for construction the civil site plans for the above referenced project. This permit must be issued within **365** days from the date of approval letter, per Kitsap County Code 12.10.055. Per the Department of Community Development/Public Works (DCD/PW) SDAP Procedure, the following documents must be uploaded to SMARTGov prior to issuing the permit placard:

1. Final Approved Plan Set
2. Final Approved Drainage Report, if revised after 90% design stage
3. Construction Stormwater Pollution Prevention Plan (SWPPP)
4. Certificate of Liability Insurance

After construction is complete the following must be uploaded to SMARTGov in order for DCD to complete the permit close-out:

1. Inspection Dates
2. Project As-builts

Please be aware of the following requirements by other agencies associated with the proposed construction

1. This project includes the construction of rock walls or other retaining facilities that either exceed four feet in height or sustain a surcharge. A separate building permit with an engineered design is required for such walls.
2. The site plan indicates that greater than 1 acre will be disturbed during construction and may require a National Pollutant Discharge Elimination System Stormwater Construction permit from the Washington State Department of Ecology. More information about this permit can be found at: http://www.ecy.wa.gov/programs/wq/stormwater/construction/ or by calling Josh Klimek at (360) 407-7451, email josh.klimek@ecy.wa.gov
   This permit is required prior to issuance of the Site Development Activity Permit. Please be aware that the minimum time between first public notice and permit issuance is 37 days.

SDAP #22-03979
North Kitsap Service Center
April 28, 2023

If we can be of further assistance, please contact **C** **O** at colsen@kitsap.gov.

This letter follows the SDAP procedure established between the two departments; please refer to the Site Development Activity Permit for Capital Projects Process Procedure document for more information on the process.

Sincerely,

Cecilia Olsen

Cecilia Olsen, Project Lead — 4/28/2023 Date

Samantha Long, Development Engineering Supervisor — 4/28/2023 Date

Cc:
Joe Rutan, PE, Kitsap County Engineer

- Kitsap County Department of Community Development, Notice of Administrative Decision for Administrative Conditional Use Permit (ACUP)

This page intentionally left blank

Kitsap County Department of Community Development

Notice of Administrative Decision

Date: 04/14/2023

To: Kitsap County Public Works, jdean@kitsap.gov
Authorized Agent: Sierra Carson, sierra.carson@otak.com
Project Manager: Jeff Massie, jeff.massie@otak.com
Interested Parties and Parties of Record

RE: Permit Number: 22-05515
Project Name: Kitsap County Public Works North Kitsap Service Center
Type of Application: Administrative Conditional Use Permit (ACUP)

The Kitsap County Department of Community Development has **APPROVED** the land use application for **Permit #22-05515 Kitsap County Public Works North Kitsap Service Center Administrative Conditional Use Permit (ACUP)**, **subject to the conditions outlined in this Notice and included Staff Report**.

THE DECISION OF THE DEPARTMENT IS FINAL, UNLESS TIMELY APPEALED TO THE KITSAP COUNTY HEARING EXAMINER ON OR BEFORE 14 DAYS FROM THE DATE OF DECISION PER KITSAP COUNTY CODE 21.04.290.

The written appeal shall be made on, or attached to, an appeal form titled: *'Appeal/Objection of an Administrative Decision'* found on DCD's website, through the Online Permit Application Portal: https://app.oncamino.com/kitsapcounty/login.

Please note affected property owners may request a change in valuation for property tax purposes, notwithstanding any program of revaluation. Please contact the Assessor's Office at 360-337-5777 to determine if a change in valuation is applicable due to the issued Decision.

The complete case file is available for review by contacting the Department of Community Development; if you wish to view the case file or have other questions, please contact help@kitsap1.com or (360) 337-5777.

CC: Kitsap County Health District, MS-30
Kitsap County Public Works Dept., MS-26
Health District
Public Works
Parks
DE & PEP
Kitsap Transit
North Kitsap Fire District
North Kitsap School District
Puget Sound Energy
Water Purveyor: KPUD 1

Point No Point Treaty Council
Suquamish Tribe
Port Gamble S'Klallam Tribe
Squaxin Island Tribe
Puyallup Tribe
WA Dept of Fish & Wildlife
WA State Dept of Ecology-SEPA
WA State Dept of Ecology-Wetland Review
WA State Dept of Transportation
DCD Staff Planner
Interested Parties: None

Kitsap County Department of Community Development

Administrative
Staff Report

Report Date: April 11, 2023 **Application Submittal Date:** November 9, 2022 **Application Complete Date:** December 9, 2022

Project Name: Kitsap County Public Works North Kitsap Service Center
Type of Application: Administrative Conditional Use Permit (ACUP)
Permit Number: 22-05515

Project Location
23044 Bond Road
NE Poulsbo, WA 98370
Commissioner District #1

Assessor's Account #
062602-2-064-2007

Applicant/Owner of Record
Kitsap County
614 Division Street
Port Orchard, WA 98366

Decision Summary
Approved subject to conditions listed under section 13 of this report.

VICINITY MAP

1. **Background**
   The North Kitsap Service Center is comprised of two facilities located on one project site: North Kitsap Road Operations Facility (ROF); and the North Kitsap Household Hazardous Waste Collection Facility (HHWCF). The two facilities have separate functions and funding sources but are co-located for project delivery and operational efficiencies. The name "North Kitsap Service Center" was adopted by the County as part of the public outreach project branding effort and to shorten the title of the overall project.

2. **Project Request**
   The proposed North Kitsap Service Center includes both a new Roads Operation Facility building and a Household Hazardous Waste Collection Facility (HHWCF). A minimum of 95 parking stalls will be provided for County-owned work vehicles, County staff vehicles, and HHWCF customers.

   The proposed Road Operations Facility is a 15,108 square foot industrial building, which

provides administrative offices for up to three supervisory personnel, crew dispatch, training, locker and washroom areas for 30 operation employees, and a vehicle and equipment maintenance shop. In addition to the operations building, the Road Operations Facility also includes 14,041 square feet of covered parking/materials storage, a 2,880 square foot equipment and vehicle wash bay, and an uncovered vehicle and equipment fueling station.

An 8,584 square foot HHWCF industrial building will also be located on the parcel for the temporary consolidation and storage of household wastes collected from the public until ultimate disposal by the County's vendors.

The project has been designed to avoid impacts to all environmentally sensitive areas on site. The required wetland and stream buffers have been maintained. The project has been designed to meet all landscaping and buffer requirements to mitigate potential impacts to surrounding residential properties. A 30-foot minimum solid screening buffer has been provided along the perimeter of the site adjacent to residential areas.

3. SEPA (State Environmental Policy Act)

The State Environmental Policy Act (SEPA), found in Chapter 43.21C RCW (Revised Code of Washington), is a state law that requires the County to conduct an environmental impact review of any action that might have a significant, adverse impact on the environment. The review includes the completion of an Environmental Checklist by the applicant and a review of that checklist by the County. If it is determined that there will be environmental impacts, conditions are imposed upon the applicant to mitigate those impacts below the threshold of "major" environmental impacts. If the impacts cannot be mitigated, an environmental impact statement (EIS) must be prepared. The decision following environmental review, which may result in a Determination of Nonsignificance (DNS), Mitigated DNS, or the necessity for an EIS is called a threshold determination. A separate notice of the threshold determination is given by the County. If it is not appealed, it becomes part of the hearing record as it was issued, since it cannot be changed by the Hearing Examiner.

Pursuant to WAC 197-11-355, the optional DNS process was utilized for this project. The SEPA Comment period previously occurred concurrent with the Notice of Application dated January 23, 2023. A Determination of Nonsignificance (DNS) was issued on March 21, 2023. SEPA noted the following information/SEPA mitigation conditions have been imposed and are listed under conditions at the end of this report.

The SEPA appeal period expired April 4, 2023. No appeals were filed; therefore, the SEPA determination is final.

4. Physical Characteristics

The subject property is 15.64 acres in size and is currently undeveloped. The property is forested and generally rolling, with moderate change in grade across the site. The property was created through a binding site plan initiated by Arness Tree Farms, the previous owner.

Table 1 - Comprehensive Plan Designation and Zoning

Comprehensive Plan: LAMIRD (Limited Area of More Intense Rural Development) Zone: Rural Employment Center	Standard	Proposed
Minimum Density	NA	NA
Maximum Density	0	
Minimum Lot Size	NA	NA
Maximum Lot Size	NA	NA
Minimum Lot Width	NA	NA
Minimum Lot Depth	NA	NA
Maximum Height	35 feet	35 feet - conditioned
Maximum Impervious Surface Coverage	85%	85% maximum conditioned
Maximum Lot Coverage	NA	NA

Applicable footnotes:

19. These zones are not intended to accommodate population growth and therefore do not have allowed density. However, limited new residential uses may occur in these zones which support the intent of these zones to provide employment and services. Therefore, up to one dwelling unit may be allowed per existing parcel for the limited residential uses allowed in Chapter 17.410.

Staff Comment: No newly created lots or residential uses are proposed.

Table 2 - Setback for Zoning District

	Standard	Proposed
Front South (Access) West (Adjacent to Bond NE Road) North (Adjacent to NE Rova Road) *Property has three fronts	20 feet	~30’ from South (Access) ~50’ from West (Bond Road) ~200’ from NE Rova Road
Side	NA No side back when there are three fronts	N/A
Side	NA No side back when there are three fronts	N/A
Rear (East)	10’	30’ (East)

Table 3 - Surrounding Land Use and Zoning

Surrounding Property	Land Use	Zoning
North	Single-Family Residences	Rural Residential (RR)
South	Commercial/Storage	Rural Employment Center (REC)
East	Single-Family Residences	Rural Residential (RR)
West	Undeveloped Land	Rural Residential (RR) and Rural Employment Center (REC)

Table 4 - Public Utilities and Services

	Provider
Water	Kitsap PUD #1
Power	Puget Sound Energy
Sewer	Kitsap County
Police	Kitsap County Sheriff
Fire	North Kitsap Fire & Rescue
School	North Kitsap School District #400

5. Access

The proposal includes two entrances off Bond Road for the facility. The driveway entrance is for the North Kitsap Household Hazardous Waste Collection Facility closer to Bond Road. Further down on the same side entrance is the driveway entry for the North Kitsap Road Operations Facility.

6. Site Design

Three structures are proposed. The proposed stormwater facilities include three detention ponds with stormwater wetlands and a detention vault. The proposed Road Operations Facility proposes a 15,108 square foot building, which provides administrative offices for up to three supervisory personnel, crew dispatch, training, locker and washroom areas for 30 operation employees, and a vehicle and equipment maintenance shop. Also included in the Road Operations Facility is 14,041 square feet of covered parking/materials storage, a 2,880 square foot equipment and vehicle wash bay, and an uncovered vehicle and equipment fueling station. The third structure is an 8,584 square foot Household Hazardous Waste Collection Facility (HHWCF). 95 parking stalls will be provided for County vehicles, County staff vehicles, and HHWCF customers.

Site design is analyzed further under Section 10 of this report.

7. Policies and Regulations Applicable to the Subject Proposal

The Growth Management Act of the State of Washington, RCW 36.70A, requires that the County adopt a Comprehensive Plan, and then implement that plan by adopting development regulations. The development regulations must be consistent with the Comprehensive Plan. The Comprehensive Plan process includes public involvement as required by law, so that those who are impacted by development regulations have an opportunity to help shape the Comprehensive Plan which is then used to prepare development regulations.

Kitsap County Comprehensive Plan, adopted June 30, 2016.

The following Comprehensive Plan goals and policies are most relevant to this application:

Capital Facilities and Utilities Goal 1. Define types of public facilities, establish standards for levels of service for each type of public facility and determine what capital improvements are needed in order to achieve and maintain the standards for existing and future populations, with a plan to repair or replace existing public facilities as necessary.

Capital Facilities and Utilities Policy 1. Coordinate provision of utilities with future development by designating appropriate sites for utility facilities and ensuring their availability.

Capital Facility and Utilities Goal 8. Ensure utilities are provided in an efficient, coordinated and timely manner between Utility providers to meet the needs of the County's future population.

Capital Facility and Utilities Policy 27. Minimize the visual impact of utility facilities on view corridors, vistas and adjacent properties by developing design standards for cellular towers, antennas and other types of utility facilities.

The County's development regulations are contained within the Kitsap County Code. The following development regulations are most relevant to this application:

Code Reference	Subject
Title 12	Storm Water Drainage
Title 13	Water and Sewers
Title 14	Buildings and Construction
Title 17	Zoning
Chapter 18.04	State Environmental Policy Act (SEPA)
Chapter 20.04	Transportation Facilities Concurrency Ordinance
Chapter 21.04	Land Use and Development Procedures

8. Documents Consulted in the Analysis

Applicant Submittals	Dated or date stamped
Administrative CUP Application	November 9, 2022
Environmental (SEPA) Checklist	November 9, 2022
Site Plan	November 9, 2022
Project Narrative	November 9, 2022
Final Health District Approval	January 9, 2023
Final Geotechnical Engineering Report	October 7, 2022
Suquamish Tribe Comments	April 3, 2023
Arborist Report	November 9, 2022
Hydrogeological Model Report	February 6, 2023
Critical Areas Report	November 9, 2022
Cultural Resources	November 9, 2022
Landscape Plans	November 9, 2022
Critical Aquifer Recharge Area Assessment	February 6, 2023
Stormwater Drainage Report 90% Design	February 10, 2023

Staff Communication	Dated
Dev. Services & Engineering Memo	March 13, 2023

9. Public Outreach and Comments

Four virtual open house events with residents in the immediate area and constituents of the North Kitsap district were held. The meetings were well attended with an average attendance of 35 and overall attendance of 140. In addition, meeting videos have been posted on the project page on the County's website. 370 views of the meetings have occurred. In addition to the meeting videos, project related information, reports and studies have been posted to the project page as they have been completed, to inform the public of the project.

The Suquamish Tribe provided comments during the SEPA Appeal Period to consider when permit conditions are being developed. The comments sought to have full dispersion or infiltration of stormwater. This is desirable as it most resembles the natural runoff condition from the uplands towards into the stream channel.

County response: The stormwater system is designed in accordance with the Department of Ecology and Kitsap County stormwater manuals. The project discharges approximately 150' upland, through undisturbed forest duff, into an unnamed Type N (non-fish bearing), ephemeral stream. The Type N stream was evaluated and categorized by two separate biologists (Ecological Land Services and OTAK). Gamble Creek is approximately ¼ mile downstream of the project discharge location. A significant proportion of site runoff will be mitigated, after water quality and rate control mitigation, in the Category 4wetland via some infiltration and some groundwater interflow.

10. Analysis

a. Planning/Zoning

The subject property is zoned Rural Employment Center (REC) which requires a Administrative Conditional Use Permit (ACUP) per Kitsap County Code 17.410.046.408 for Public facilities greater than 300 square feet. "Public facilities" is defined in 17.110.640 as streets, roads, highways, sidewalks, street and road lighting systems, traffic signals, domestic water systems, stormwater infrastructure, sanitary sewer systems, pump houses, waste handling facilities designated as public facilities in the comprehensive solid waste management plan, public works storage facilities and road sheds, and utilities such as power, fiber-optic, gas, phone and cable television. This does not include wireless communication facilities as defined in this title.

The project meets all the zoning setbacks required in Kitsap County Code 17.420 Density, Dimensions, Design. Please see Table 2 on page 3.

Kitsap County Code 17.415.400 requires public facilities to meet the following criteria:

A. Public facilities of any size shall meet the following criteria:

1. These provisions do not apply to wireless communication facilities, which are specifically addressed in Chapter 17.530.

   Staff Comment: No wireless communication facilities are proposed in this application.

2. The erection, construction, alteration, or maintenance of overhead or underground utilities by a public utility, municipality, governmental agency, or other approved party shall be permitted in any zone.

   Staff Comment: The use is allowed in the REC zone with an Administrative Conditional Use Permit.

3. In the forest resource lands (FRL) zone, public facilities shall not inhibit forest practices.

Staff Comment: The submitted proposal is not within the FRL zone.

4. In the mineral resource overlay (MRO), public facilities shall not inhibit mineral resource extraction, processing, or production.

Staff Comment: The proposal is not within the MRO zone.

5. Water towers which exceed the height requirements of the zone in Chapter 17.420, solid waste collection, or transfer and/or handling sites in any zone shall be subject to a conditional use permit (C).

Staff Comment: No water towers are proposed within this application. The submitted proposal is for a hazardous waste facility not a solid waste collection, transfer, and/or handing site which has greater usage. Hazardous waste will come from residents dropping off household hazardous wastes (e.g. used paint, florescent bulbs, pesticides, cleaners, etc).

6. Utility transmission and distribution lines and poles may exceed the height limits otherwise provided for in this title.

Staff Comment: No utility transmission and distribution lines are proposed.

7. The public facility shall not substantially interfere with or detract from the intent of the zone district, as determined by the director.

Staff Comment: The Rural Employment Center (REC) zone provides for isolated areas of industrial and commercial type uses in the rural areas of Kitsap County. The REC is not required to principally serve the existing and projected rural population, but rather to promote the rural economy by providing and creating jobs close to home. The project meets this intent through the ACUP.

8. The public facility shall provide a solid screening buffer to mitigate impacts on the visual character of a neighborhood as seen from rights-of-way or adjacent properties. Landscaping shall be installed and maintained in conformance with the requirements of Chapter 17.500.

Staff Comment: The proposal includes a landscaping plan that include a solid screen buffer around the project. The project is conditioned for a solid screen fence.

9. Noise, odor, dust and light impacts shall be mitigated from adjacent properties consistent with Section 17.105.110, Obnoxious things.

Staff Comment: The project is conditioned for artificial outdoor lighting shall be arranged so that the lighting is fully recessed or fully shielded from side view and directed downward and away from surrounding properties. No more than one foot-candle of illumination shall leave the property boundary. Lighting shall be the minimum necessary for safety purposes and be compatible with the rural character of the area. Light standards (poles) shall not exceed 20 feet in height.

In addition, Site operation will be limited to daytime working hours (approximately 7:30am-4:30pm), except in the case of an emergency operations, such as a snow event where operations may change to 24 hours for a limited duration of time. This will mitigate noise impacts.

10. Additional review for stormwater management may be required consistent with Title 12, Storm Water Drainage.

Staff Comment: The proposal has been reviewed for Title 12 elements and have conditioned the project appropriately. In addition, the project will require a Site Development Activity Permit (SDAP) in which Stormwater will be further reviewed.

b. Lighting

Artificial outdoor lighting shall be arranged so that the lighting is fully recessed or fully shielded from side view and directed downward and away from surrounding properties. No more than one foot-candle of illumination shall leave the property boundary. Lighting shall be the minimum necessary for safety purposes and be compatible with the rural character of the area. Light standards (poles) shall not exceed 20 feet in height.

c. Off-Street Parking

The proposed project meets the parking standards of Kitsap County Code Chapter 17.490 Off Street Parking and Loading.

Table 5 - Parking Table

Use Identified in 17.490.030	Standard	Required Spaces	Proposed Spaces/Existing Spaces
*Manufacturing, Research, Testing, Processing and Assembly Facilities *Closest use to North Household Hazardous Waste Collection Facility (HHWCF) *Professional Office Closest use for North Kitsap Road Operations Facility	1 per 1,000 square feet Proposed facility is 8,584 square ft 1 per 300 square feet of gross floor area	8.5 required round up to 9 50.36 spaces required – round to 50	

	Proposed Road Operations Facility is 15,108 square ft		
Total		9+50= 59 spaces	95 proposed

d. Signage

Any sign proposed for the subject property will require a sign permit.

e. Landscaping

All proposed buffers and plantings will comply with KCC 17.500, Landscaping. A minimum 30-foot buffer has been provided along the perimeter to screen the proposed development. This buffer meets the solid screening requirements found in KCC 17.500.027 by providing at least two rows of evergreen trees offset by 10 feet and conditioned for a six foot tall solid screening fence.

Table 6 - Landscaping Table

	Required	Proposed
Required Landscaping (Sq. Ft) 15% of Site	15%	22%
Required Buffer(s) 17.500.025		
North	Solid Screening Buffer	Solid Screening Buffer
South	Solid Screening Buffer	Solid Screening Buffer
East (Bond Rd)	Solid Screening Buffer	Solid Screening Buffer
West	Solid Screening Buffer	Solid Screening Buffer
Street Trees	No	No

f. Frontage Improvements

No frontage improvements were required for this project.

g. Design Districts/Requirements

The subject property is not within a Design District.

h. Development Engineering/Stormwater

Development Engineering has reviewed the above land use proposal and finds the concept supportable in its approach to civil site development with nine conditions. These comments are based on a review of the Preliminary Drainage Report and Preliminary Engineering Plans accepted for review December 12, 2022 to Kitsap County Development Engineering.

i. Environmental

The critical area map is shown below. The property has two wetlands and one unnamed stream on site. Wetland C requires a 50' buffer. In addition, Wetland A is an offsite wetland with a 150' buffer protruding into the subject property. The onsite unnamed stream has an 150' buffer. All project activity will also be located outside of the wetland and stream buffers. Because the project is meeting all buffer requirements, no mitigation is required.

The project is located within a Category II Critical Aquifer Recharge Area. The application includes a Critical Aquifer Recharge Area Assessment prepared by Aspect Consulting dated February 6, 2023. The report concluded "the vulnerability of both aquifers to long-term cumulative and short-term risk from contamination from the proposed Project is considered to be low, provided that the project is designed in accordance with the 2019 Stormwater Management Manual for Western Washington (SMMWW; Ecology, 2019), including applicable BMPs and the recommendations in this report are observed." The project is conditioned to follow the recommendations of this report. The project has been reviewed for Title 12, Stormwater Management and conditionally approved.

There was also a Conceptual Hydrogeologic Model Report prepared by Aspect consulting dated February 6, 2023. The report proposed the implementation of Best Management Practices (BMPs) to eliminate and/or mitigate significant risks to groundwater quality and nearby water supply wells as a result of the planned improvements for the facility. The project is conditioned to follow the recommendations of the report.

The application also includes a Geotechnical Engineering Report prepared by Aspect Consulting dated October 7, 2022. The report concluded, "based on our geotechnical evaluation of the Site that included data review, a Site reconnaissance, subsurface

explorations, and geotechnical engineering analyses, the Project is feasible from a geotechnical perspective—provided the recommendations contained here are properly incorporated into the Project final design and construction." The project shall be conditioned to follow the recommendations of the report.

Also submitted was a Cultural Resources Assessment prepared by Cultural Resource Consultants dated April 15, 2021. The assessment was conducted to determine potential effects of this project on cultural resources. Investigations included pedestrian survey and excavation of 12 shovel probes. A ca. 1890s to 1910s glass bottle scatter (45KP318) was identified in a road cut in the southwest corner of the project location. The surface scatter was of low density and in a disturbed context. It is recommended as ineligible for listing on historic registers. No other cultural resources were identified within the project location. No additional cultural resources investigation is recommended at this time. A determination of "no historic properties affected" is recommended. The project is conditioned that if project activities result in the discovery of archaeological materials, project staff should halt work in the immediate area and contact the technical staff at DAHP and representatives of identified area Tribes.

An Arborist Report prepared by John Lewis ISA Arborist/TRAQ certified was submitted. The report assessed trees within a prescribed area provided by OTAK along Bond Rd. NE, Lamird Rd. and NE Rova Rd for the North Kitsap Service Center project in early development of utilities and roads with the objective of retaining as many viable, healthy trees as possible in lieu of the impending development. This parcel was previously an active timber forest from the 1950's and is mostly populated with Douglas firs (90%) interspersed with a few Western redcedars, White pines and Alders. Additionally, there are some young and semi-mature Cottonwoods located near the wetlands and stream. Due to extensive root damage from clearing and grading for the creation of Lamird Rd. and the installation of water lines along Bond Rd. NE, the report recommended most of trees in the areas impacted by early construction will need to be removed. However, vegetation off the Rova Rd. area of this assessment reveals an opportunity to preserve and maintain natural vegetation. The project is conditioned to follow the recommendations of the report.

j. Access, Traffic and Roads

Adequate vehicular access is proposed via NE Gunderson Rd, a county-maintained Right of Way.

k. Fire Safety

Kitsap County Fire Marshal's office has reviewed the project and approved with one condition.

l. Solid Waste

Solid waste review will occur under the Site Development Activity Permit.

m. Water/Sewer

Potable water is proposed to be provided by Kitsap Public Utility District; sanitary sewage disposal is proposed to be provided by an on-site septic system.

n. Kitsap Public Health District

A building site application will be required during the building permit reviews. There are no known closed or abandoned landfills within 1,000 ft of this parcel. Additionally, there are no known Site Hazard Assessments performed by KPHD at this parcel.

11. Review Authority

The Director has review authority for this Administrative Conditional Use Permit application under KCC, Sections 17.540.020 and 21.04.100. The Kitsap County Commissioners have determined that this application requires review and approval of the Director. The Director may approve, approve with conditions, or deny an Administrative Conditional Use Permit.

12. Findings

1. The proposal is consistent with the Comprehensive Plan.

2. The proposal complies or will comply with requirements of KCC Title 17 and complies with or will comply with all other applicable provisions of Kitsap County Code and all other applicable regulations, including all applicable development standards and design guidelines, through the imposed conditions outlined in this report.

3. The proposal is not materially detrimental to existing or future uses or property in the immediate vicinity.

4. The proposal is compatible with and incorporates specific features, conditions, or revisions that ensure it responds appropriately to the existing character, appearance, quality or development, and physical characteristics of the subject property and the immediate vicinity.

13. Decision

Based upon the analysis above and the decision criteria found in KCC 17.540.040.A, the Department of Community Development recommends that the Administrative Conditional Use Permit (ACUP) request for the North Kitsap Service Center be **approved**, subject to the following 30 conditions:

a. Planning/Zoning

1. All required permits shall be obtained prior to commencement of land clearing, construction and/or occupancy.

2. This permit shall comply with all Kitsap Public Health District regulations and conditions of approval.

3. Landscaping shall be installed and maintained in conformance with the requirements of Kitsap County Code (KCC) 17.500. Landscaping shall be installed and inspected prior to requesting a final inspection or guaranteed by means of an assignment of funds or bonded in the amount of 150 percent of the cost of installation. Proposal shall include a solid screening fence.

4. Any and all signage design and location (including exempt signs) shall comply with Kitsap County Code (KCC) 17.510 and be reviewed and approved by the Department of Community Development prior to installation. Signage may require a separate permit.

5. The recipient of any administrative conditional use permit shall file a Notice of Land Use Binder with the county auditor prior to any of the following: initiation of any further site work, issuance of any development/construction permits by the county, or occupancy/use of the subject property or buildings thereon for the use or activity authorized. The Notice of Land Use Binder shall serve both as an acknowledgment of, and agreement to abide by the terms and conditions of the administrative conditional use permit and as a notice to prospective purchasers of the existence of the permit. The Binder shall be prepared and recorded by the Department at the applicant's expense.

6. The uses of the subject property are limited to the uses proposed by the applicant and any other uses will be subject to further review pursuant to the requirements of the Kitsap County Code (KCC). Unless in conflict with the conditions stated and/or any regulations, all terms and specifications of the application shall be binding conditions of approval. Approval of this project shall not, and is not, to be construed as approval for more extensive or other utilization of the subject property.

7. The decision set forth herein is based upon representations made and exhibits contained in the project application (Permit #22-05515). Any change(s) or deviation(s) in such plans, proposals, or conditions of approval imposed shall be subject to further review and approval of the County and potentially the Hearing Examiner.

8. The authorization granted herein is subject to all applicable federal, state, and local laws, regulations, and ordinances. Compliance with such laws, regulations, and ordinances is a condition to the approvals granted and is a continuing requirement of such approvals. By accepting this/these approvals, the applicant

represents that the development and activities allowed will comply with such laws, regulations, and ordinances. If, during the term of the approval granted, the development and activities permitted do not comply with such laws, regulations, or ordinances, the applicant agrees to promptly bring such development or activities into compliance.

9. This Administrative Conditional Use Permit approval shall automatically become void if no development permit application is accepted as complete by the Department of Community Development within four years of the Notice of Decision date or the resolution of any appeals.

10. Any violation of the conditions of approval shall be grounds to initiate revocation of this Administrative Conditional Use Permit.

11. Construction plans and profiles for all roads, storm drainage facilities and appurtenances prepared by the developer's engineer shall be submitted to Kitsap County for review and acceptance. No construction shall be started prior to said plan acceptance.

12. Site operation will be limited to daytime working hours (approximately 7:30am-4:30pm), except in the case of emergency operations, such as a snow event where operations may change to 24 hours for a limited duration of time.

13. Artificial outdoor lighting shall be arranged so that the lighting is fully recessed or fully shielded from side view and directed downward and away from surrounding properties. No more than one foot-candle of illumination shall leave the property boundary. Lighting shall be the minimum necessary for safety purposes and be compatible with the rural character of the area. Light standards (poles) shall not exceed 20 feet in height.

b. Development Engineering

14. The information provided demonstrates this proposal is a Large Project as defined in Kitsap County Code Title 12 and as such will require a Full Drainage Site Development Activity Permit (SDAP) from Development Engineering.

15. Stormwater quantity control, quality treatment, and erosion and sedimentation control shall be designed in accordance with Kitsap County Code Title 12 effective at the time of SDAP application. The submittal documents shall be prepared by a civil engineer licensed in the State of Washington. The submittal requirements shall be in accordance with Kitsap County Code in effect at the time of SDAP application. (SDAP #22-03979 being reviewed concurrently)

16. The site plan indicates that greater than 1 acre will be disturbed during

construction. This threshold requires a National Pollutant Discharge Elimination System (NPDES) Stormwater Construction permit from the State Department of Ecology. More information about this permit can be found at: http://www.ecy.wa.gov/programs/wq/stormwater/construction/html or by calling Josh Klimek at (360) 407-7451, email joshklimek@ecy.wa.gov This permit is required prior to issuance of the SDAP. Processing time for NPDES permit is a minimum of 37 days.

17. This project includes the construction of a detention vault, which requires a building permit issued by the Department of Community Development. A Structural Engineer, registered in the State of Washington, shall design the vault and prepare the construction drawings. In addition, a geotechnical engineering analysis of the vault design is required. That analysis shall be prepared by a Civil Engineer licensed in the State of Washington, and knowledgeable in the practice of soils engineering and mechanics. The analysis shall address the effects of groundwater infiltration, seepage, potential slip planes, and changes in soil bearing strength. The proposed facilities shall be designed following the recommendations of the geotechnical analysis.

18. If the project proposal is modified from that shown on the site plan approved for this permit application, Development Engineering will require additional review and potentially new conditions.

19. This project includes the construction of rock walls or other retaining facilities that either exceed four feet in height or sustain a surcharge. A separate building permit with an engineered design is required for such walls. This note shall be placed on the face of the final construction drawings.

20. Rock and retaining walls shall meet all applicable setback requirements of Vol. II, Chapter 9 of the Kitsap County Stormwater Drainage Manual.

c. Environmental

21. Permit approval subject to chapter 19.300.315 of Kitsap County Code, which states that buffers or setbacks shall remain undisturbed natural vegetation areas except where the buffer can be enhanced to improve its functional attributes. Refuse shall not be placed in buffers.

22. A 150-foot native vegetation buffer shall be retained along the perimeter of the stream as depicted on the approved site plan. In addition, a building or impervious surface setback line of 15 feet is required from the edge of the buffer.

23. A 50-foot native vegetation buffer must be maintained along the delineated wetland boundary as depicted on the approved site. In addition, a building or

impervious surface setback line of 15 feet is required from the edge of the buffer.

24. Prior to occupancy, the common boundary between the STREAM and WETLAND buffer and the adjacent land shall be permanently identified with critical area buffer signs. A total of 50 (10 for wetland and 40 for stream) Critical Area Ordinance (CAO)signs shall be placed along the designated boundary spaced approximately 50-feet apart, visual from sign to sign. Signs must be attached to existing trees with diameter breast height greater than 4 inches. Alternative methods include 4x4 posts, metal posts or split rail fencing. Signs are provided at issuance and installation of the signs is required prior to final inspection and Certificate of Occupancy (CO).

25. The proposal occurs within a Category II Critical Aquifer Recharge Area. The proposed operation and design features described in the Hydrogeological Report - prepared by Aspect consulting dated February 6, 2023. are hereby incorporated as proposed mitigation measures for aquifer protection.

26. The project shall follow the recommendations of the Critical Aquifer Recharge Area Assessment prepared by Aspect Consulting dated February 6, 2023.

27. The project shall follow the recommendations of the Geotechnical Engineering Report prepared by Aspect Consulting dated October 7, 2022.

28. If project activities result in the discovery of archaeological materials, project staff should halt work in the immediate area and contact the technical staff at DAHP and representatives of identified area Tribes.

29. The project shall follow the recommendations of the Arborist Report was submitted prepared by John Lewis ISA Arborist/TRAQ certified.

d. Traffic and Roads

None

e. Fire Safety

30. Fire Department access consisting of 20' unobstructed with shall be provided throughout site. Access, fire hydrant placement, and fire flow will be determined at time of SDAP review. During building plan review it may be determined at fire sprinklers, fire alarms, and additional fire code permit may be required.

f. Solid Waste

None

g. Kitsap Public Health District
None

Report prepared by:

Katharine Shaffer 4-10-23
Katharine Shaffer, Planning Supervisor / Project Lead Date

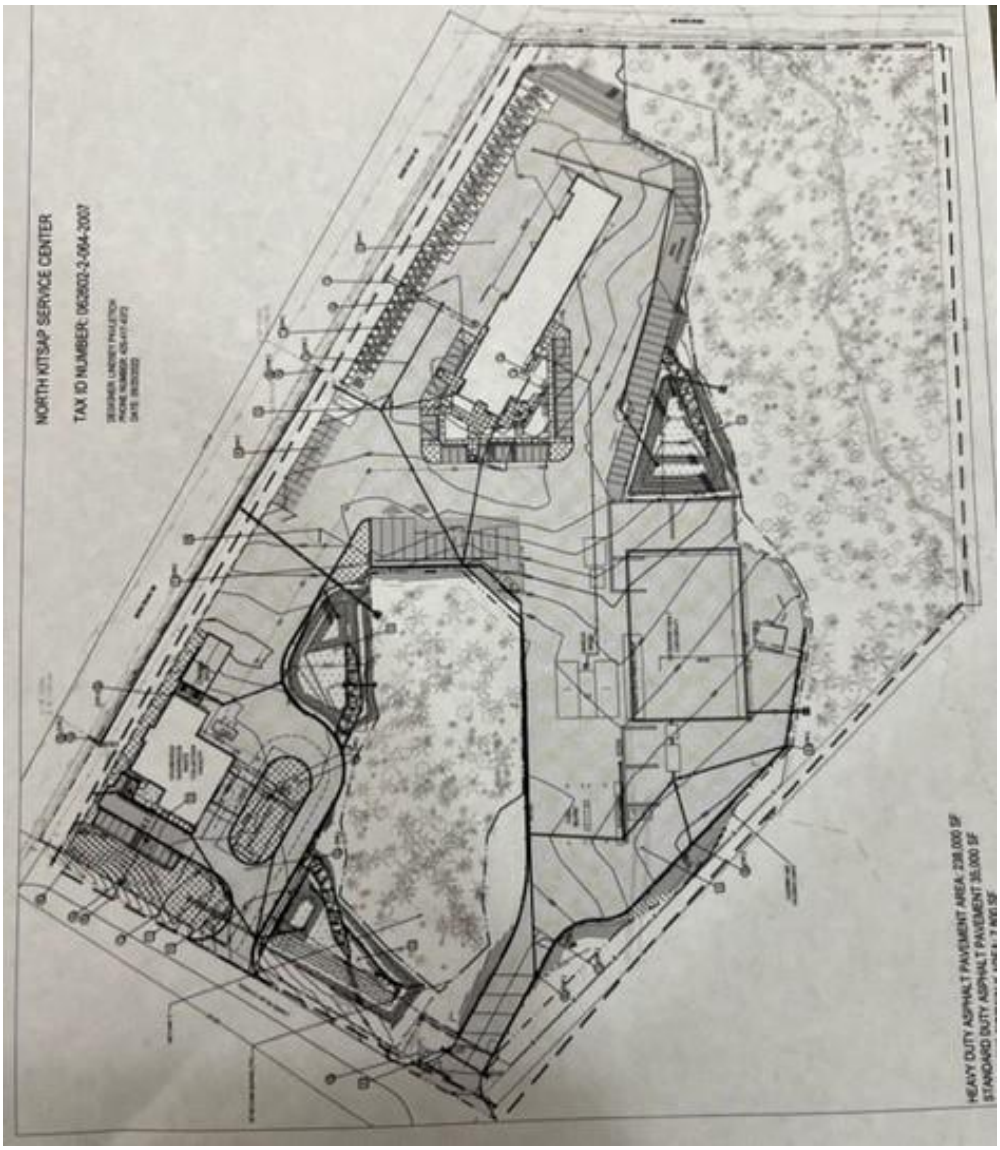
Report approved by:

4/10/2023
David Kinley, Assistant Director Date

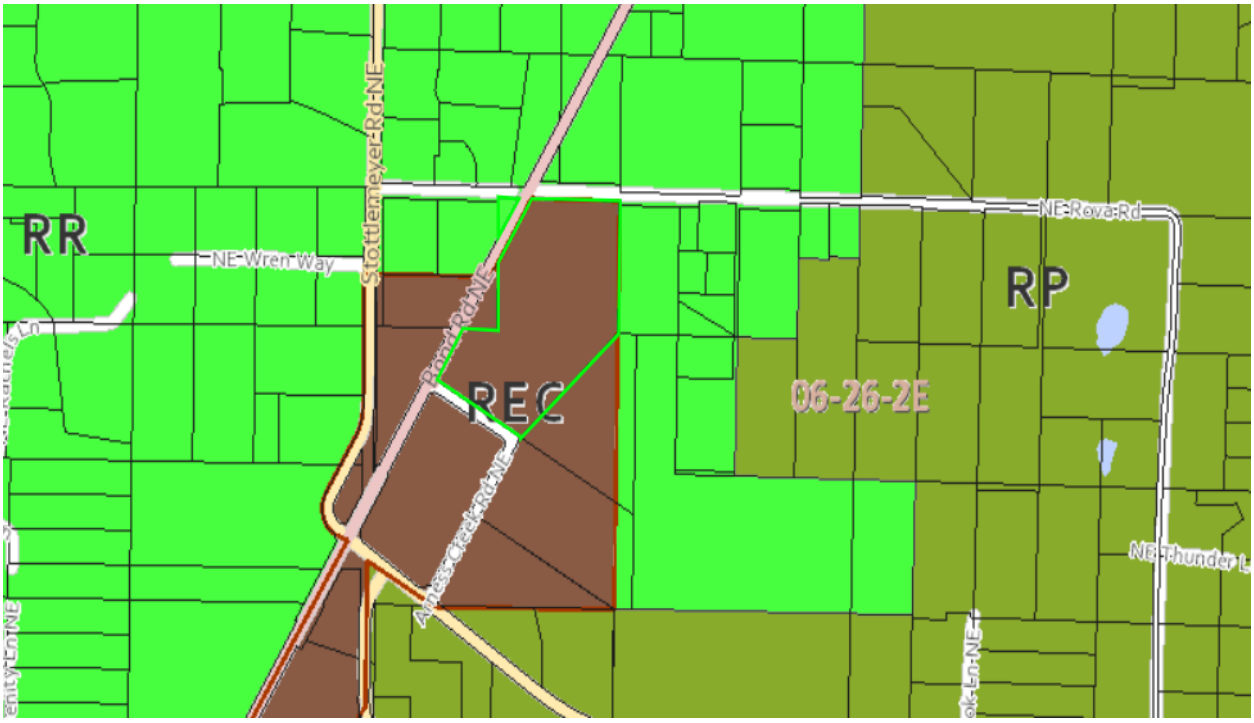
Attachments:
Attachment A – Site Plan
Attachment B – Zoning Map (Required)

CC: Applicant/Owner
Engineer / Project Representative
Interested Parties: None
Kitsap County Health District, MS-30
Kitsap County Public Works Dept., MS-26
DCD Project Lead: Katharine Shaffer

Site Plan
Attachment A



Attachment B – Zoning Map



- Washington State Department of Ecology,
  Coverage under the Construction Stormwater General Permit

This page intentionally left blank

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47600, Olympia, WA 98504-7600 • 360-407-6000

May 5, 2023

Jacques Dean
Kitsap County Public Works Road Department
507 Austin Ave
Port Orchard, WA 98366

RE: Coverage under the Construction Stormwater General Permit

Permit number:	**WAR312437**
Site Name:	**North Kitsap Service Center**
Location:	**Along NE Rova Rd and State Route 307/Bond Rd NE Poulsbo, WA County: Kitsap**
Disturbed Acres:	**8.5**

Dear Jacques Dean:

The Washington State Department of Ecology (Ecology) received your Notice of Intent for coverage under Ecology's Construction Stormwater General Permit (CSWGP). This is your permit coverage letter. Your permit coverage is effective May 5, 2023.

Retain this letter as an official record of permit coverage for your site. You may keep your records in electronic format if you can easily access them from your construction site. You can get the CSWGP, permit forms, and other information at Ecology's CSWGP eCoverage Packet webpage[1]. Contact your Permit Administrator, listed below, if you want a copy of the CSWGP mailed to you. Please read the permit and contact Ecology if you have any questions.

Electronic Discharge Monitoring Reports (WQWebDMR)
This permit requires you to submit monthly discharge monitoring reports (DMRs) for the full duration of permit coverage (from the first full month of coverage to termination). Your first sampling and reporting period will be for the month of **June** and your first DMR must be submitted by **July 15, 2023**.

[1] http://www.ecology.wa.gov/eCoverage-packet

You must submit your DMRs electronically using Ecology's secure online system, WQWebDMR. To sign up for WQWebDMR go to Ecology's WQWebPortal guidance webpage[2]. If you have questions, contact the portal staff at (360) 407-7097 (Olympia area), or (800) 633-6193/Option 3, or email WQWebPortal@ecy.wa.gov.

Appeal Process

You have a right to appeal coverage under the general permit to the Pollution Control Hearing Board (PCHB). Appeals must be filed within 30 days of the date of receipt of this letter. Any appeal is limited to the general permit's applicability or non-applicability to a specific discharger. The appeal process is governed by chapter 43.21B RCW and chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2). For more information regarding your right to appeal, please reference Ecology's Focus Sheet: *Appeal of General Permit Coverage*[3].

Annual Permit Fees

RCW 90.48.465 requires Ecology to recover the costs of managing the permit program. Permit fees are invoiced annually until the permit is terminated. Termination conditions are described in the permit. For permit fee related questions, please contact the Water Quality Fee Unit at wqfeeunit@ecy.wa.gov or (800) 633-6193/Option 2.

Ecology Field Inspector Assistance

If you have questions regarding stormwater management at your construction site, please contact your Regional Inspector, Charles Hackel of Ecology's Northwest Regional Office in Shoreline at charles.hackel@ecy.wa.gov, or (425) 213-9832.

Questions or Additional Information

Ecology is here to help. Please review our Construction Stormwater General Permit webpage[4] for more information. If you have questions about the Construction Stormwater General Permit, please contact your Permit Administrator, Melinda Wilson at melinda.wilson@ecy.wa.gov, or (360) 870-8290.

Sincerely,

Jeff Killelea, Manager
Program Development Services Section
Water Quality Program

[2] https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Water-quality-permits-guidance/WQWebPortal-guidance
[3] https://apps.ecology.wa.gov/publications/summarypages/1710007.html
[4] www.ecology.wa.gov/constructionstormwaterpermit

Appendix D

Example Baseline Schedule of Values

This page intentionally left blank

North Kitsap County Maintenance Facility

EXAMPLE BASELINE SCHEDULE OF VALUES

Contract for: **North Kitsap Maintenance Facility**

Location: **23026 Route 307 / Bond Road NE, Poulsbo, WA 98370**

PRIME / SUBCONTRACTOR	SPECIFICATION SECTION	SCHEDULE OF VALUES DETAIL	ESTIMATED VALUE
		Bond	
		Temporary Erosion/Water Pollution Control	
		Silt Fence	
		Delineation Fencing	
		Wetland Delineation	
		Construction Entrance	
		Wheel wash	
		Dust Abatement	
		Street Sweeping	
		Miscellaneous Best Management Practices	
		TESC and SWPPP Plans and Submittals	
		TESC and SWPPP Inspection and Reporting	
		Spill Prevention Plan and Implementation	
		Surveying	
		Detailed Field Survey Submittal	
		Clearing and Grubbing Limits, and Property Corner Staking Submittal	
		Slope Staking Submittal	
		Subgrade Staking Records	
		Alignment Surfacing Grade Stakes Submittal	
		Surfacing Grade Stakes Submittal	
		Main Buildings Staking Submittal	
		Outbuildings and Structures Staking Submittal	
		Storm Drainage and Pond Staking Submittal	
		Septic and Sewer Staking Submittal	
		Water Line Staking Submittal	
		Electrical Duct Banks Staking Submittal	
		Roadway Paving Pins for Surfacing for Paving Submittal	
		Coordinates for the Alignment Calculations Submittal	
		Type B Schedule	
		Type B Schedule Submittal	
		Mobilization	
		Mobilization - 1% or 10% (whichever is least)	
		Mobilization - 5% or 50% (whichever is least)	
		Mobilization - 10% or 90% (whichever is least)	
		Mobilization - Remaining 10% (upon Substantial Completion)	
		Operation and Maintenance Manuals	
		Electrical O&Ms	
		Mechanical O&Ms	
		Fire System O&Ms	
		Communication O&Ms	
		Security O&Ms	
		Gates O&Ms	
		Septic O&Ms	
		Generator O&Ms	
		Vehicle Wash O&Ms	
		EV Charger O&Ms	

North Kitsap County Maintenance Facility

EXAMPLE BASELINE SCHEDULE OF VALUES

Contract for: **North Kitsap Maintenance Facility**

Location: **23026 Route 307 / Bond Road NE, Poulsbo, WA 98370**

PRIME / SUBCONTRACTOR	SPECIFICATION SECTION	SCHEDULE OF VALUES DETAIL	ESTIMATED VALUE
		Vehicle Wash O&Ms	
		Brine Maker O&Ms	
		Other O&Ms	
		Excavation Support Systems	
		Excavation Support Systems Design Submittal	
		Excavation Support Systems in Place	
		Excavation Including Haul	
		Paid by Cubic Yard -- No need to be in Schedule of Values.	
		Embankment Compaction	
		Paid by Cubic Yard -- No need to be in Schedule of Values.	
		Gravel Borrow Including Haul	
		Paid by Ton -- No need to be in Schedule of Values.	
		HMA	
		HMA Paid by Ton -- No need to be in Schedule of Values.	
		CSTC	
		CSTC - Paid by Ton -- No need to be in Schedule of Values.	
		CSBC	
		CSBC - Paid by Ton -- No need to be in Schedule of Values.	
		Site Improvements	
		Clearing and Grubbing	
		Walls by Each	
		Storm Drainage Pond 1	
		Storm Drainage Pond 2	
		Stormwater Structures	
		Detention Vault	
		Biofiltration Vault	
		Hydrodynamic Separator	
		Watermain System	
		Onsite Sewage System (OSS)	
		Irrigation System	
		Landscaping	
		Excavating, Stockpiling, and Placing Native Topoil	
		Hot Mix Asphalt (HMA) Paving Berms	
		Rigid Paving	
		Sidewalk	
		Curb and Gutter	
		Curbs	
		Precast Wheel Stops	
		Bollards	
		Pavement Striping and Markers	
		Chain Link Fencing	
		Wood Fencing	
		Automatic Gates	
		Monument Sign	
		Traffic Signs	
		Flagpole System	

North Kitsap County Maintenance Facility

EXAMPLE BASELINE SCHEDULE OF VALUES

Contract for: **North Kitsap Maintenance Facility**

Location: **23026 Route 307 / Bond Road NE, Poulsbo, WA 98370**

PRIME / SUBCONTRACTOR	SPECIFICATION SECTION	SCHEDULE OF VALUES DETAIL	ESTIMATED VALUE
		Site Plumbing	
		Covered Parking Structures / Bridge Crane	
		Dry Sprinkler System for Covered Parking	
		Trash Enclosures	
		Materials Bulk Storage Walls	
		Salt Storage and Brine Maker/Street Sweeping Structures	
		Details: Footings, Steel, etc. - Separate Work Components	
		Sander Insert Rack and Major Work Components	
		Vehicle Wash System and Wash Bay Structure and Major Work Components	
		HVAC Major Equipment and Work Components	
		Electrical	
		Mechanical	
		Dry Sprinkler System for Vehicle Wash	
		Fuel Station System Station	
		Fuel Tanks	
		Fuel Island	
		Site Fire Protection System	
		Site Electrical System	
		Electronic Safety and Security Major Work Components	
		Site Lighting System	
		Site Technology System	
		Generator and Transfer Switches	
		Electrical Duct Banks	
		Propane Tanks	
		Dewatering	
		Water Storage Tanks	
		Electrical Vehicle Chargers	
		Below Grade Containment Tanks	
		Anticipated Material on Hand (MOH)	
		Road Operations Facility	
		Excavation/Backfill	
		Embankment Compaction	
		Foundation	
		Tilt-up Walls	
		Utilities	
		Slab	
		Polished Concrete Finishing	
		Structural Steel Framing	
		Trusses	
		Roofing	
		Metal Stairs	
		Steel Decking	
		Pipe and Tube Railings	
		Perforated Metal Panels	
		Composite Wall Panels	
		Metal Wall Panels	

North Kitsap County Maintenance Facility

EXAMPLE BASELINE SCHEDULE OF VALUES

Contract for: **North Kitsap Maintenance Facility**

Location: **23026 Route 307 / Bond Road NE, Poulsbo, WA 98370**

PRIME / SUBCONTRACTOR	SPECIFICATION SECTION	SCHEDULE OF VALUES DETAIL	ESTIMATED VALUE
		Interior Walls	
		Insulation	
		Gutter Systems	
		Canopies	
		Doors	
		Overhead Coiling Doors	
		Ceiling Tiles	
		Multipurpose Room Ceiling Architectural Panels	
		Room Finishes	
		Windows	
		Window Shades	
		Storefronts	
		Electrical	
		Switchboards	
		Panel Boards	
		Lighting	
		Enclosed Bus Assemblies	
		Electronic Safety and Security Major Work Components	
		Communications	
		Mechanical	
		HVAC Major Equipment and Work Components	
		Fire Protection System	
		Tire Changer and Balancer Equipment	
		Hydronic Flooring	
		Vehicle Lift Equipment	
		Vehicle Wash System	
		Lube Room Equipment	
		Shop Equipment	
		Plumbing	
		Toilet, Bath, Laundry and Cleaning Accessories	
		Housekeeping Pads	
		Casework	
		Countertops	
		Signage	
		Appliances	
		Bridge Crane	
		Cantilever Storage Racks	
		Fans	
		Anticipated Material on Hand (MOH)	
		Household Hazardous Waste Collection Facility Building	
		Excavation/Backfill	
		Embankment Compaction	
		Foundation	
		Tilt-up Walls	
		Utilities	
		Slab	

North Kitsap County Maintenance Facility

EXAMPLE BASELINE SCHEDULE OF VALUES

Contract for: **North Kitsap Maintenance Facility**

Location: **23026 Route 307 / Bond Road NE, Poulsbo, WA 98370**

PRIME / SUBCONTRACTOR	SPECIFICATION SECTION	SCHEDULE OF VALUES DETAIL	ESTIMATED VALUE
		Polished Concrete Finishing	
		Structural Steel Framing	
		Trusses	
		Metal Stairs	
		Steel Decking	
		Pipe and Tube Railings	
		Perforated Metal Panels	
		Composite Wall Panels	
		Metal Wall Panels	
		Roofing	
		Interior Walls	
		Insulation	
		Gutter Systems	
		Canopies	
		Doors	
		Overhead Coiling Doors	
		Ceiling Tiles	
		Room Finishes	
		Windows	
		Window Shades	
		Storefronts	
		Electrical	
		Switchboards	
		Panel Boards	
		Lighting	
		Enclosed Bus Assemblies	
		Electronic Safety and Security Major Work Components	
		Communications	
		Mechanical	
		HVAC Major Work Components	
		Fire Protection System	
		Hydronic Flooring	
		Stationary Loading Dock Equipment	
		Plumbing	
		Toilet, Bath, Laundry and Cleaning Accessories	
		Housekeeping Pads	
		Casework	
		Countertops	
		Signage	
		Appliances	
		Anticipated Material on Hand (MOH)	
		Start-up and Commissioning	
		Start-up and Commissioning	
		Final Cleaning	
		Final Cleaning by Building and Site	
		Record Drawings	

North Kitsap County Maintenance Facility

EXAMPLE BASELINE SCHEDULE OF VALUES

Contract for: **North Kitsap Maintenance Facility**

Location: **23026 Route 307 / Bond Road NE, Poulsbo, WA 98370**

PRIME / SUBCONTRACTOR	SPECIFICATION SECTION	SCHEDULE OF VALUES DETAIL	ESTIMATED VALUE
		Record Drawings	
		Photo-voltaic System	
		Photo-voltaic System	

Appendix E

Appraisal of Timber, S.A. Newman Firm, August 2018

This page intentionally left blank

APPRAISAL OF TIMBER

Within a 14± Acre Proposed Acquisition Area on Real Property legally described as that portion of Section 6, Township 26 North, Range 2 East, W.M., Kitsap County, Washington, described as Parcel II in Exhibit "A" of that title report dated January 30, 2018 issued by Pacific Northwest Title; order no. 32163844

Portion of Kitsap County Tax Parcel 062602-1-018-2006

Report date: August 23, 2018
Date of Valuation: August 7, 2018

under *Uniform Standards of Professional Appraisal Practice* (USPAP)
and (if applicable) guidelines of *RCO Policy Manual 3, Section 5*
when used with report of lead property appraiser

Prepared exclusively for:
Client: Richards & Associates, its principal Gary D. Lyman, MAI and, as additional intended user, Kitsap County, a Washington domestic corporation

Prepared by:
S. A. Newman Firm
3216 Wetmore Avenue
Post Office Box 156
Everett, WA 98206-0156
Telephone: 425-259-4411
tnewman@sanforest.com

This page intentionally left blank

Appraisal and Appraisal Review Services
Forest Practices Consulting, Timber Cruising and Marketing Established 1946

S. A. NEWMAN FIRM
(incorporated as S.A. Newman, Forest Engineers, Inc.)

Offices: 3216 Wetmore Avenue, Suite 205, Everett, WA 98201-4368
Mail: P. O. Box 156, Everett WA 98206-0156
Phone 425-259-4411; Facsimile 425-258-4435
Web: www.sanforest.com

CONFIDENTIAL August 23, 2018

Via email: gary-lyman@comcast.net
Mr. Gary D. Lyman, MAI, President
Richards & Associates
908 Bertha Avenue
Bremerton, WA 98312

Re: Cruise and appraisal of timber within proposed acquisition area on property owned by Arness Tree Farms Inc., a Washington corporation; portion of parcel 062602-1-018-2006

Dear Mr. Lyman:

At your request, our firm has prepared an appraisal to estimate the contributory value of merchantable timber located within a 14± acre proposed acquisition area on an 81.86-acre unit of real property located in the northern part of Kitsap County, Washington. A fee simple estate in this timber is valued in conformance with the *Uniform Standards of Professional Appraisal Practice* (USPAP) and, if applicable, guidelines of *RCO Policy Manual 3, Section 5* when used with report of lead property appraiser.

Permitted users; functions. This cruise and timber appraisal have been prepared for the sole and exclusive use of our firm's client Richards & Associates, its principal Gary D. Lyman, MAI and, as additional intended user, the firm's client Kitsap County, a Washington domestic corporation. The sole function of the cruise and timber appraisal is to assist the lead property appraiser in establishing the market value contribution of the proposed acquisition area in order to establish a purchase offer by your client in a voluntary transaction.

Indications of contributory timber value: The timber is described in detail in this report. Based upon our timber cruise, investigation and analysis of available information, the estimated contributory market value of merchantable timber within proposed acquisition area under a **Class IV-General** forest practice (i.e., with prospective near term land use conversion) totals **Ninety-Three Thousand Dollars ($93,000)** as of August 7, 2018.

This value estimate is a *net* figure, adjusted and reduced for costs of harvest, log haul, marketing and other costs. When existent, timber valuable principally as an amenity or is legally non-harvestable, where existent, is customarily valued as a unit with the underlying land. This estimate also adjusts for any uncertainty in marketplace about extent of permitted volume at prospective harvest dates; marketing and management costs; prospective time lag to receipt of timber or log sale proceeds; and risk and profit to landowner in resale of timber commodity.

As a general guideline lead appraisers do, once concluding a highest and best use, usually opt to include the value contribution of on-site timber based on either a Class III (or Class IV-General without land use conversion) or Class IV-General (with land use conversion) forest practice. Market practices vary, however, in areas transitioning from resource oriented to other uses: hence, III and IV-G often serve as parameters. If corresponding timber on land sales used as comparables is valued as a unit within the underlying land, however, a similar practice potentially applies to the subject timber to avoid "double counting" of this asset component. The lead appraiser ultimately estimates value contribution based on review of prevailing practices in locale and property sale comparables.

As discussed, total property value is expected to be maximized under a Class IV-General conversion forest practice, depending on the trade-off between diminished land value as a result of timber cutting, and foregone stumpage value by leaving this timber uncut. A sales comparison or other market analysis of the lead property appraiser might also assist in corroborating this determination.

RCW 76.09.060(3)(d) as amended July 2007 prohibits conversion to a land use other than "commercial forest product operations within six years after approval of the forest practices application or notification without the consent of the county ... to which the forest practices operations would have been subject if the application had stated an intent to convert." Actual permitted harvest in land use conversions is subject to county review on a case-by-case basis. A harvest compliant with conversion guidelines—a Class IV-General conversion forest practice—is generally more restrictive than permitted under other classes of forest practice.

On-site timber. A representative of the S. A. Newman Firm cruised merchantable timber within proposed acquisition area of this property on August 7, 2018. The "variable radius plot: method of estimating merchantable timber volume by species is the most typical method employed in the private sector for similar properties in the subject market area. As documented in Addendum C, sampling accuracy at one standard deviation averages 8.3 percent (based on net board feet per acre, combined for all species); 6.6% based on basal area per acre.

Extraordinary assumptions or hypothetical conditions: This appraisal is not subject to any extraordinary assumption within the meaning of Standards Rule 1-2(f) of USPAP or hypothetical condition under Standards Rule 1-2(g).

The indicated estimate of market value is subject to the conditions and comments presented in this report of 64 pages. Please feel free to phone us at 425/259-4411 (fax 425/258-4435) if you have any questions. Thank you.

Respectfully Submitted,

S. A. NEWMAN FIRM

Timothy D. Newman, MAI, CF
Partner
WA State Certified-General Appraiser 1100664
Certification expires Feb. 27, 2019
Email: tnewman@sanforest.com

TABLE OF CONTENTS

Part I – INTRODUCTION Page

Letter of Transmittal 1
Table of Contents 4
Certification of Appraiser 5
Definitions and Standards 7
General Limiting Conditions 9

PART II – FACTUAL DATA

Timber Cruise Summary 11
Description of On-Site Timber/Physiography 12
Harvest Regulatory Constraints 12

Part III – DATA ANALYSIS AND CONCLUSION OF VALUE

Valuation Methodology 15
Estimation of Average Log Values 17
Estimation of Logging Costs 22
Indications of Contributory Merchantable Timber Value 24

Part IV – SUPPLEMENTAL EXHIBITS AND ADDENDA

A: Timber Statement of Work (Engagement Instructions); Title Report dated January 30, 2018 ..... A1

B: Proposed Acquisition Area Overlain on Overhead Aerial Photo; Overhead Aerial Photo of Entire Parcel Area; Third Party Wetland Delineation; Topographic/Water Type ("Activity") Map; State DNR Resource Map; U.S. NRCS Soils Map and Data; Priority Habitat and Species Report (WDFW); and Highlights of DNR Economic Forecast (June 2018) B1

C: Plot Grid Location Sketch; Unadjusted Board Foot Volumes by Species and Sort, other Cruise Detail & Project Statistics C1

D: Qualifications of Appraiser D1

CERTIFICATION OF APPRAISER

I certify that, to the best of my knowledge and belief:

The statements of fact contained in this report are true and correct and no important facts have been withheld.

The reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and are my personal, impartial, and unbiased professional analyses, opinions, and conclusions.

I have no present or prospective interest in the property that is the subject of this report and no personal interest with respect to the parties involved.

I have no bias with respect to the property that is the subject of this report or to the parties involved with this assignment.

We have performed no services, as an appraiser or in any other capacity, regarding the property that is the subject of this report within the three-year period immediately preceding acceptance of this assignment [a disclosure status required by the Ethics Rule of USPAP].

Our firm's engagement in this assignment was not contingent upon developing or reporting predetermined results.

Our firm's compensation for completing this assignment is not contingent upon the development or reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value opinion, the attainment of a stipulated result, or the occurrence of a subsequent event directly related to the intended use of this appraisal. Moreover, this appraisal assignment is not based on a requested minimum or maximum valuation, a specific valuation, or the approval of a loan.

The appraisal was developed and the appraisal report prepared (when used with report of lead property appraiser) in conformance with the Appraisal Standards Board's *Uniform Standards of Professional Appraisal Practice*; and also prepared in conformity with the Code of Professional Ethics and Standards of Professional Practice of the Appraisal Institute.

Richard B. Klein personally inspected the appraised property that is the subject of this report on behalf of the S. A. Newman Firm on the ground on August 7, 2018. Timothy D. Newman did not inspect this site. Adam L. Jewell assisted in researching delivered log values and logging costs. No other persons assisted in preparing the analyses, conclusions and other opinions concerning real property which are set forth in this appraisal report.

Our firm has not revealed the findings and results of such report to anyone other than the client named herein, and our firm will not do so until authorized in writing by said party, or until required to do so by due process of law. The use of this report is, however, subject to the requirements of the Appraisal Institute relating to review by its duly authorized representatives.

In my opinion, the estimated market value contribution of the timber being appraised under the alternative forest practices scenarios indicated is as stated in the letter of transmittal attached hereto as of the date specified therein. This report is subject to a specified extraordinary assumption and a hypothetical condition as communicated in the letter of transmittal attached hereto.

As of the date of this report, Timothy D. Newman has completed the requirements under the continuing education program of the Appraisal Institute; and is licensed as a Certified Real Estate Appraiser (General Classification) under RCW 18.140. Current certification expires February 27, 2019. A statement of the appraiser's qualifications, including education, technical training and experience, is attached hereto.

Timothy D. Newman, MAI, CF
Partner
WA State Certified-General Appraiser 1100664
Certification expires Feb. 27, 2019
Email: tnewman@sanforest.com

DEFINITIONS AND STANDARDS

As used herein:

(1) "Market value" is "the most probable price, as of a specified date, in cash, or in terms equivalent to cash, or in other precisely revealed terms, for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress." [*The Dictionary of Real Estate Appraisal*, 6th Edition, 2015, p. 141.]

(2) "Cash equivalent" means a price expressed in terms of cash as distinguished from a price that is expressed all or partly in terms of the face amount of notes or other securities that cannot be sold at their face amount. The cash equivalent price of a sale property may differ from its contract price and should represent the present worth at time of sale of all cash and other considerations paid for the real property or timber as opposed to other portions of stated consideration that may be paid for services, fees, and/or other non-realty items.

(3) "Extraordinary assumption" means an assignment-specific assumption as of the effective date regarding uncertain information used in an analysis which, if found to be false, could alter the appraiser's opinions or conclusions. [Source: USPAP, 2018-2019 edition, p. 3.]

(4) "Highest and best use" means the reasonably probable and legal use of vacant land or an improved property that is physically possible, legally permissible, appropriately supported, financially feasible, and that results in the highest value. [Source: the *Appraisal of Real Estate*, Fourteenth ed., Appraisal Institute 2013].

(5) "Hypothetical condition" means a condition, directly related to a specific assignment, which is contrary to what is known by the appraiser to exist on the effective date of the assignment results, but is used for purposes of analysis. [Source: USPAP, 2018-2019 edition, p. 4.]

(6) "Jurisdictional Exception" means an assignment condition established by applicable law or regulation, which precludes an appraiser from complying with a part of USPAP. [Source: USPAP, 2018-2019 edition, p. 4.]

(7) "Sales comparison approach" means a method of estimating property value by comparing the property being appraised to similar properties that have been sold near the date of value, applying appropriate units of comparison, and making adjustments to the sale prices of the comparables based on the elements of comparison.

(8) "Fee simple estate" means the absolute ownership unencumbered by any other interest or estate, subject only to the limitations imposed by the governmental powers

of taxation, eminent domain, police power, and escheat. Source: *The Dictionary of Real Estate Appraisal, Fifth edition*, Appraisal Institute 2010, p. 78.

(9) "Site index" measures the potential productivity of the land for growing timber. A site index indicates the height an average dominant tree of a given species will attain on that site in a well stocked stand in a period of 50 years. Sources of site indices: USDA Natural Resources Conservation Service and S. A. Newman Firm.

(10) "Stumpage value" means the estimated value of merchantable trees which have not been severed from the land.

(11) "Log value" means the value of logs which have been severed from the land and delivered (a "delivered log"), either to a processing mill site or to a place of lading for export.

(12) "Logging cost" means the estimated sum of those costs, including truck haul, severance tax, and a factor for risk and profit to the logger, which are required to convert stumpage into logs delivered at a processing mill site or at a place of lading for export.

(13) "Conversion return approach" means the method of estimating stumpage value by deducting logging costs from log value. This method of valuing stumpage assumes that the value of a tree equals the price that it will command delivered at a processing mill site or at a place of lading for export, less the logging costs to be incurred in converting it from stumpage to delivered logs.

(14) "Sales comparison approach" means a method of estimating either property value or stumpage value by comparing the property or timber being appraised to similar properties that have been sold near the date of value, applying appropriate units of comparison, and making adjustments to the sale prices of the comparables based on the elements of comparison.

(15) Cruising standards: Variable radius plot cruise in merchantable timber stands specified in a later report section.

(16) Size specifications: Cruised and graded in variable log lengths minimum top diameter for sawlogs = 5 inches, inside bark. All live trees containing at least one sixteen foot log to a 5-inch top diameter are assumed to be merchantable.

GENERAL LIMITING CONDITIONS

This appraisal is subject to the following general limiting conditions:

The legal description for the subject property is derived from records furnished by the client and is assumed to be correct. A title report on the subject property has not been made available to the appraiser. No opinion as to title is rendered, which is assumed to be marketable.

Any sketches or maps in this report are included solely to assist the reader in visualizing the property, and are not surveys. We have not surveyed the property or established corners, and assume no responsibility in connection with such matters.

It is assumed, for the purpose of this appraisal, that Kitsap County and Washington State Department of Natural Resources will grant a permit for the cutting and removal of this timber. Trees required to be left uncut as a condition of receiving a development permit are excluded herein.

The appraisal estimates the market value of the indicated timber but does not analyze the relationship between the value of these assets and that of stock or other securities or partnership interests through which the assets may be held.

The statements of value and all conclusions shall apply as of the date shown herein. The value of standing timber is volatile and can change quickly.

Log market contacts, profit expectations, and perceptions of the offered timber typically vary widely among different prospective purchasers. Hence, amounts bid or offered in sales of standing timber also vary widely among these parties at any given date.

This report must be used in its entirety. Reliance on any portion of the report independent of others, may lead the reader to erroneous conclusions regarding the opinion of value. The S. A. Newman Firm does not authorize the partial re-printing of or out-of-context quoting from this report.

While reasonable care has been exercised in preparing and compiling estimates of timber volume and grade and other information contained herein, the S. A. Newman Firm (a) makes no warranties and/or representations as to the type, quality, quantity and/or suitability of timber located on the Property; (b) makes no express or implied warranties of merchantability or fitness for a particular purpose; and (c) makes no warranties and/or representations about whether, when or to what extent forest practices permit(s) will be issued to permit the harvest of this timber. In addition, S. A. Newman, Forest Engineers, Inc. has not performed a soil survey. Statements concerning site drainage and operability of the terrain by yarding equipment are opinions only.

When applicable species grades are allocated between timber deemed to be exportable as unprocessed logs ("exp") and timber deemed to be converted domestically ("dom"). This allocation is based on the actual distribution in the regional marketplace for a given grade and species as of the date of appraisal. A given allocation adjusts for differences in log length, surface clearness, and other quality size characteristics among various stands. The distribution of subject timber by a particular purchaser may differ from the assumed allocation.

Permitted users; functions. This cruise and timber appraisal have been prepared for the sole and exclusive use of our firm's client Richards & Associates, its principal Gary D. Lyman, MAI and, as additional intended user, the firm's client Kitsap County, a Washington domestic corporation. The sole function of the cruise and timber appraisal is to assist the lead property appraiser in establishing the market value contribution of the proposed acquisition area in order to establish a purchase offer by your client in a voluntary transaction.

Neither all nor any part of the contents of this report shall be conveyed to any person or entity, other than the above named parties, through advertising solicitation materials, public relations, news, sales, or other media without the written consent and approval of the author(s), particularly as to valuation conclusions, the identity of the appraiser or firm with which the appraiser is connected, or any reference to the Appraisal Institute. Further, the appraiser or firm assumes no obligation, liability, or accountability to any party except our client Richards & Associates and its principal Gary D. Lyman, MAI. If this report is placed in the hands of anyone but the client, client shall make such party aware of all the assumptions and limiting conditions of the assignment.

While reasonable care has been exercised in preparing the information and opinions herein, prospective purchasers and third parties are urged to retain their own experts and conduct and rely solely upon their own inspection and analysis of the property and its future prospects. The appraiser is in no way responsible for any costs incurred to discover or correct any deficiency in the property. The appraiser assumes that there are no hidden or unapparent conditions of the property or subsoil which would render it more or less valuable. Description of environmentally critical areas illustrate certain reported on-site conditions but is not intended to describe all environmentally critical areas which might exist.

We have been provided no information regarding the presence or absence of hazardous waste on the subject property. None was observed during our inspection. This report assumes the absence of any and all hazardous waste on the subject property. If hazardous waste is found to be present on the subject property, we reserve the right to change the valuation contained in this report.

Extraordinary assumptions or hypothetical conditions: This appraisal is not subject to any extraordinary assumption within the meaning of Standards Rule 1-2(f) of USPAP or hypothetical condition under Standards Rule 1-2(g).

PART II – FACTUAL DATA
Timber Cruise Summary

Description of Merchantable Timber on Selected Property Owned By:
Arness Tree Farms Inc., a Washington corporation

Legal Description: A 14± acre proposed acquisition area mapped on attachment in Addendum B, being part of Section 6, Township 26 North, Range 2 East, W.M., Kitsap County, Washington, described as Parcel II in Exhibit "A" of that title report dated January 30, 2018 issued by Pacific Northwest Title; order no. 32163844; being a portion of Kitsap County tax parcel 062602-1-018-2006.

Estimated total acres: 81.86 acres (source: assessor records).
Proposed acquisition area: approximately 14 acres
Merch. acres within proposed acquisition area: 10.4±
Cruise intensity: 16 variable radius plots, two-thirds of trees therein fully measured and graded
Cruised by: Richard B. Klein, August 7, 2018

Cruise Summary: Estimated net volume in thousands of board feet and projected harvest volume under a Class IV-General forest practice as of cruise date:

Species	Unadjusted Field Net[1]	Adjusted Net Volume[2]	Class IV-General Harvest[3]
Douglas fir	202	197	138
Hemlock	19	18	13
R. Cedar	42	34	24
Alder	32	31	22
Cottonwood	3	3	0
Totals	298	283	197

Log grade composition by species is itemized in a following log value analysis in Addendum C along with other cruise detail.

[1]Source: cruise by representative of the S. A. Newman Firm. Unadjusted field net and cruise detail in Addendum C are unadjusted for minor hidden defect and prospective breakage. Volumes shown exclude timber within no-cut riparian buffer under WAC 222-30-021 and unstable areas.

[2]Adjusted net volume adjusts for hidden defect and minor prospective breakage based on species, age, timber size, site conditions and projected harvest methods. Also of note: Statistical sampling error on red cedar as a stand alone species shown in Addendum C is sharply higher than that of principal species Douglas fir. Harvest volume for red cedar projected for appraisal purposes is, moreover, typically adjusted more significantly because of (i) greater uncertainty and variation about extent of hidden defect; and (ii) normal variation in empirical cut-out disproportionately skews value outcome on this higher valued species.

[3]Projected harvest volume under a Class IV-General forest practice excludes timber on those portions of site projected as environmentally critical under the county's critical areas ordinance and timber (if any) potentially more valuable as an amenity than as stumpage. Such timber is valued as a unit with the underlying land. When applicable, a Class III forest practice typically excludes only minor wildlife reserve and green recruitment trees to the extent required under WAC 222-30-020.

Description of Timber/Physiography

Description of timber types: Douglas fir composes about 70% of on-site timber volume; average to very good quality and moderately limby to clear; averages 16" dbh with average bole length of 60 feet. Red cedar composes about 12% of projected harvest volume; averages 15" dbh with average bole length of 49 feet.

Physiography: U.S. NRCS maps principal soil within proposed acquisition area as Poulsbo gravelly sandy loam, 0 – 6% slopes, a "moderately deep, moderately well drained soil" formed in glacial till. Permeability is rated as moderately rapid above the hardpan and very slow through it. Forested and scrub-type wetland on two strips as delineated by Ecological Land Services in mapping in Addendum B. Based on a 50-year site curve, mean site index for Douglas fir on the Poulsbo series averages 121 feet; above average in forest site productivity. Annual precipitation averages 35 inches [source: NOAA].

Access: Bond Road N.E., a paved county road, borders northwest side of proposed acquisition area and the remainder property. NE Rova Road borders north side of acquisition area. Interior is unroaded.

Harvest Regulatory Constraints

Land use conversions. RCW 76.09.060(3)(d) as amended July 2007 prohibits conversion to a land use other than "commercial forest product operations within six years after approval of the forest practices application or notification without the consent of the county ... to which the forest practices operations would have been subject if the application had stated an intent to convert." Actual permitted harvest in land use conversions is subject to county review on a case-by-case basis. A harvest compliant with conversion guidelines—a Class IV-General forest practice—is generally more restrictive than permitted under other classes of forest practice. In particular, harvest is generally prohibited on those parts of a site regulated under the county critical areas ordinance such as steep slopes, other geologically hazardous areas, wetland and frequently flooded areas.

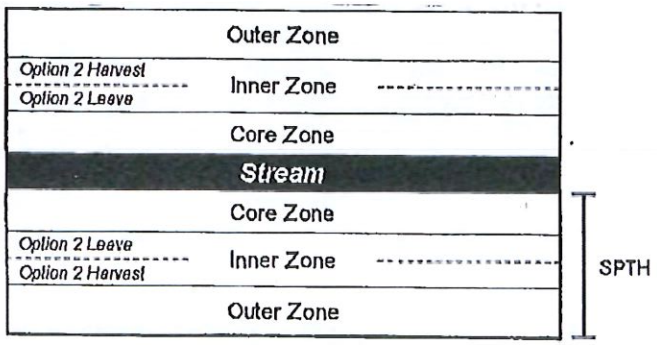
Forest Practices. RCW 76.09 and WAC 222 regulate forest land use and forestry operations on private lands and public lands under State jurisdiction, including road construction and maintenance, timber harvesting, reforestation and use of forest chemicals. A permit to perform major forest practices is subject to review by the Washington State Departments of Natural Resources, Ecology, Fish and Wildlife, and (under a Class IV-General forest practice) by Kitsap County.

In western Washington the "Forest and Fish Rules" (WAC 222-30-021) require a three-zone riparian harvest buffer along either side of a fish-bearing stream (figure below). The total combined buffer width is one site potential tree height (SPTH), which is 90-200 feet depending on site quality. The zone adjacent to the stream is a 50-foot no-harvest core zone. This is followed by the inner zone, in which two partial harvest

options are allowed subject to minimum tree count and basal area requirements. Option 1 allows thinning from below throughout the inner zone to a minimum of 57 conifers per acre. Option 2 divides the inner zone into two portions, allowing the trees furthest from the stream to be removed (up to a minimum distance of 80 feet from the stream) while the trees in the portion closest to the stream are retained. The final zone is the outer zone, in which partial harvest is allowed with a minimum retention of 20 conifers per acre that are at least 12" in diameter.

In addition to the above described riparian protective measures, a 50-foot no-harvest buffer is generally prescribed each side of type N stream for a distance greater than or equal to fifty percent of a type N water length upstream from confluence with fish-bearing water, where type N water is less than 1,000 feet in length. Additional 50-foot "no-harvest" buffer on each side of type N stream is required greater than 1,000 feet upstream from confluence with fish bearing water ranging from 19 to 45% of stream length above 1,000-foot mark.

The goal of the Westside buffer rules is to put the development of riparian stands on a trajectory toward a desired future condition (DFC) of mature forest structure intended to provide high quality riparian habitat. This DFC is defined as "the stand conditions of a mature riparian forest at 140 years of age" (WAC 222-16-010). In addition to this ecological goal, the FFR also have the concurrent economic goal of "maintaining commercial forest management as an economically viable use of lands suitable for that purpose." RCW 77.85.180.



FFR buffers for Western WA.

These rules were revised on August 12, 2009 to require slightly larger buffer zones and more trees to be left alongside streams and rivers in the state during timber harvests and other activities. In February 2010 a fixed width, no harvest buffer by site productivity was made optionally available to forest practices applicants under an "Alternate Plan" to standard forest practices rules. The fixed width buffer generally assumes no harvest in core and inner zones and also no harvest in a small portion of outer zone.

RMAP status. State DNR regulates road construction, maintenance and abandonment under WAC 222-24. On some sites, the cost of such work is substantial and therefore materially affects value. When applicable, a landowner or its successor in interest is generally liable for performing uncompleted maintenance or abandonment work prescribed under an approved plan for the property at issue. In this instance interior of proposed acquisition area is unroaded. When existent, spur roads determined to be "orphaned" (if any) are defined as a road or railroad grade "not used for forest practice activities since 1974. WAC 222-24-052(4). Landowners generally are not obligated to repair or abandon such roads.

Watershed Analysis. The forest practices rules allow for special regulations, i.e. watershed prescriptions, within watershed analysis units ("WAU") where a qualified multi-disciplinary team completed an approved resource assessment under WAC 222-22. The subject parcel sits within the Bangor-Port Gamble #150203. No formal resource assessment nor analysis has been performed in this WAU; thus standard forest practices apply.

Wildlife and other issues. In addition to riparian restrictions intended to protect fish habitat and water quality, certain restrictions potentially apply to forest practices to protect terrestrial and avian wildlife. The northern spotted owl (STOC) is listed as state endangered (SE) and federally threatened (FT). The subject sits, however, outside of a spotted owl special emphasis area (SOSEA) under permanent rules adopted on May 22, 1996 to protect habitat of this species. The Port Gamble quad of public data release map issued by State of Washington Department of Fish and Wildlife ("WDFW") indicates, moreover, that the site sits outside of a management circle of established territory for this species. And, it lacks sufficient habitat for this species. The undersigned also consulted the Washington State Department of Natural Resources "Resource" maps to corroborate PHS map data. The resource map also does not identify any rare plants or archeological issues of concern. Timber harvesting is expected to be unaffected by plants or archeological issues.

PART III – DATA ANALYSIS AND CONCLUSIONS OF VALUE

Valuation Methodology

The valuation process used herein is based on analysis of pertinent general and specific data. A conversion return method—a variant of an income approach--is relied upon in this instance with respect to on-site timber, reflecting the type of property, the intended use of the appraisal, the identified scope of work, and the quality and quantity of data available for analysis. The State has not offered or sold export-unrestricted sales usable as potential comparables due to the Act noted below; and such sale data are generally unavailable from alternative sources. A present net worth analysis—a variant of an income approach—is applied in estimating the value contribution of on-site sub-merchantable stands and a younger reproduction stand.

The Forest Resources Conservation and Shortage Relief Act of 1990 (Public Law 101-382) (the "Act") restricts the export of unprocessed timber originating from State and other public land. Chapter 240-15 of the Washington Administrative Code implements these restrictions, beginning January 1, 1991. Generally, the Act requires each agency managing public lands to designate timber sales to be sold as export-restricted and as exportable. The Act prohibits the export of unprocessed timber from export-restricted sales, but permits the export of unprocessed timber from export-unrestricted sales. Moreover, the Act does not apply to privately owned forest land. The Ninth Circuit Court of Appeals in May 1993 ruled that this Act violated 10th Amendment guarantees of state sovereignty. *Board of Natural Resources v. Brown*, 92-35004. The Act was, however, reinstated in slightly amended form; and as amended upheld state regulations adopted pursuant to the 1990 law. The extent that timber from public and private land is actually exported remains subject to normal qualitative and market constraints.

We first analyzed the subject stumpage for the purpose of evaluating those factors which would add to or detract from its value, such as log quality, location, accessibility, logging conditions, road construction requirements, and proximity to market. We also analyzed site factors to identify whether a land use more intensive than timber growing and harvesting might be permitted in the near to mid-term. The existence of environmentally sensitive conditions such as steep slopes, wetlands, intervening streams, critical aquifers, and flood, erosion, landslide and seismic hazards often preclude more intensive uses under the critical areas ordinance adopted by the County.

Timber within proposed acquisition area is valued under the premise of a prospective Class IV-General forest practice only as described on prior pages.

Other adjustments in estimating value contribution. The indicated estimates of value contribution of this sub-merchantable timber adjusts for nominal uncertainty only in the marketplace about the extent of permitted volume at prospective harvest dates; marketing and management costs; prospective time delay to receipt of timber or log

sale proceeds; and risk and profit to landowner in resale of on-site timber. A value adjustment of approximately fifteen percent (15%) is typically applied for these collective elements to merchantable-sized timber on operational-type stands that are expected to be legally harvestable under a Class IV-General forest practice. Adjustment is higher when economies of scale are less.

An adjustment for *each* of these foregoing items in line item form is not inferable from available market data relevant to this particular property: property and survey data usually support, however, a *collective* adjustment for these elements in deriving indications of contributory stumpage value.

Indications of contributory timber value reflects current log market conditions, aligned with current price forecasts included at end of Addendum B. Commodity pricing can, however, change sharply over short term periods.

Estimation of Average Log Values

The compilation of log prices from private sources involved our contact with mills and other log buyers in the market area to survey prices being paid for delivered logs of various grades and species at the valuation date, and of analyzing these data to estimate average log values.

Reconciled value for each log sort is appraiser's reconciled estimate derived from personal interview with various log buyer sources or published sources as of August 7, 2018. Export-type logs were priced as non-FAS and assumed an average log length of 36 feet or greater. Export logs range from 26 to 40 feet; domestic logs range from 12 feet to 40 feet.

Log prices have been surveyed in the south Puget Sound market area. Sources surveyed are itemized below and on a following page.

The reconciled log value rates on following pages are appraiser's estimate of log values, weighted to reflect reliability of sources and relative quantity purchased. It is assumed that the property owner would, subject to normal market and quantitative constraints, sell harvestable timber or logs at the highest available price. Specific sources do not, however, consistently quote high relative prices for all grades or sorts of a given species. Therefore, although reconciled values generally appear near the upper end of the range of price quotes, it is impracticable to procure the highest price quotes for all grades and sorts. Reconciled log value for some sorts only falls outside or exceeds range of quotes in order to reconcile with quotes for other sorts which are qualitatively superior or inferior. Reconciled value also reflects that some destinations are preferred to minimize hauling cost if net stumpage value is thereby maximized. These data are then applied to the subject timber based on the indicated log grade composition.

Logs produced from the subject property are deliverable to south Puget Sound area market.

Sources A through N in table 1 are coded on the following pages to protect confidentiality of prices attributable to specific sources. These sources of log price data, all operating in Puget Sound and vicinity are cited following table 1 (sources in parenthesis were considered but not relied upon in identifying project log buyers and destinations).

Table 1. Log prices quoted from various sources to processing mill site as basis for reconciled value in south Puget Sound areas and vicinity as of August 7, 2018.

			Source								
			A	B	C	D	E	F	G	H	X
Douglas fir	Exp	3PJ	760	800	800		775				
		SMJ	930	900	800		775				880
		2J	985	900	750		725				
		2K	760	900	750		725				
		2C	760	700	550		525				
		3J/K	945	900	750		725				
		3C	760	700	750		725				
	Dom	OVS*	550	400	550		525				
		2S	640	400	550	743	525	750			772
		3S	640	400	750	743	725	750			741
		CnS/4S	590	200	725	670	700	710			678
		pulp							315	350	
					I		J		$39/T	$42/T	
Hemlock/ Grand fir	Exp	SMJ	710	375	700		450				
		2J	710	700	700		450				
		2K	680	700			400				
		2C	680	700			400				
		3J	700	650	700		400				
		3K	700	650			400				
		3C	680	650			400				
	Dom	OVS*	300	375			250				
		2S	300	300		658	400	640			638
		3S	300	300		658	400	640			663
		CnS/4S	300	150		595	275	615			552
		Pulp					125		370	380	
					C		$14/T		$41/T	$42/T	
Spruce	Exp	8"+		650			300				
	Dom	OVS		375	165						
		2S		300	165	650	300				655
		3S		300	165	650	300				655
		CnS/4S		150	165	587	125				505
		Pulp					125		310	320	
							$16/T	K	$39/T	$40/T	
Pine	Exp	8"+		NB							
	Dom	2S		NB	165	650		325			
		3S		NB	165	650		300			
		CnS/4S		NB	165	587					
		Pulp						125	290	300	
								$17/T	$39/T	$40/T	

			Source				
			B	J	L	M	X
Red cedar	Dom:	OVS*	1,100	1,100	1,300	1,150	1,075
		3S	1,100	1,100	1,350	1,350	1,075
		4S		775	1,100	1,250	1,075
		Pulp		100			

		Source						
		B	J	N	G	H	K	X
Alder	Veneer 13"+		1,000				1,450	
	Veneer 12"		1,000				1,100	
	12"+	550	625	900			800	914
	10-11"	550	625	875			765	885
	8-9"	500	625	850			715	885
	6-7"		400	750			550	725
	5"		150	600			400	
	Pulp		150	300	205	300	125	
			$18/T	$35/T	$24/T	$35/T	$14/T	
Maple	Figure wood							
	OVS*						450	
	12"+	150	300	525			330	525
	10-11"	150	300	500			330	484
	8-9"		125	475			330	484
	6-7"		125	450				430
	5"							
	Pulp		125	240	195		125	
			$15/T	$30/T	$24/T		$15/T	
Cottonwood	24"P		100					200
	12-23"	220	100					200
	8-11"	220	100					
	Pulp		100		120			200
			$13/T		$16/T			$27/T

OVS* means oversized, typically >32"DBH

Species	**Destinations** (other sources surveyed in parenthesis)
Douglas fir	All export to Weyerhaeuser at Olympia, except China sorts to Formark at Fredrickson. Domestic 2S to SPI at Shelton, all other domestic to Manke at Tacoma. Pulp to Willis Enterprises at Belfair; (Hampton at Morton, DaPaul Chip at Tumwater).
Hemlock	All export to Formark at Fredrickson. Domestic to SPI at Shelton. Pulp to Willis Enterprises at Belfair; (Hampton at Randle, Weyerhaeuser at Olympia, Manke at Shelton & Tacoma and DaPaul Chip at Tumwater).
Alder	All sawlogs to Northwest Hardwoods at Centralia. Pulp to Northwest Hardwoods at Tumwater; (Willis Enterprises at Belfair, Formark at Fredrickson, Cascade Hardwoods at Chehalis, Port Angeles Hardwoods at Port Angeles and Defiance Forest Products at Shelton &Tumwater).
Red cedar	All sawlogs to ALTA at Kamilche; (ALTA at Morton, Reichert Shake and Fencing at Toledo, Formark at Fredrickson, Holbrook at Olympia and ALTA at Port Angeles).

Log destinations reflect comparative log pricing and hauling cost to maximize net stumpage value.

Log Price Basis

Species	Sort	Grade	%		Delivered Value	Weighted Log Value
Douglas fir	Exp	SM	5	@	$ 930	
		2J	18		985	
		2K	12		985	
		2C	13		760	
		3J	9		945	
		3K	5		945	
		2K-OVS	3		650	
	Dom	2S	9		750	
		3S	14		750	
		C&S/4S	8		725	
		Pulp	4		350	$837
Hemlock	Exp	3J	30		700	
		3K	26		700	
	Dom	2S	24		640	
		C&S/4S	15		615	
		Pulp	5		370	656
Red cedar	Dom	3S	72		1,350	
		4S	28		1,100	1,280
Alder	Saw	12"	11		900	
		8-9"	9		850	
		6-7"	22		750	
		Pulp	58		300	514

Notes: Price for each log grade is appraiser's reconciled estimate derived from various log buyer sources as of July 31, 2018. All prices are second growth, per MBF. Export-type logs were priced to brow log (not FAS), prices on conifer export volume assume an average log length of 36 feet, ranging from 26 to 40 feet. Domestic prices assume an average log length of 32 feet.

Estimation of Logging Costs per MBF under Class IV-General forest practice:

Fee for temporary road use permit	$0
Road reconstruction:	0
Road construction: 2 stations @ $1,800/197 MBF	18
"Stump to truck" elements (fall & buck, yard & load, operator's overhead, and risk and profit to operator only)	110
Truck haul (per following page)	103
Fire protection & slash disposal*	7
Engineering, surveying and permits	18
Washington state timber excise tax	30
Total:	$286/M

Other supporting data on following page. Road construction rate includes move-in/move-out and low economies of scale

Yarding & loading: Class IV-General: 100% ground-based yarding @ rate indicated.

Note: Net value is unadjusted for cost of reforestation, which is generally required by law under WAC 222-34 unless the harvest application indicates that the land will be converted to another use. WAC 222-34-010 details other exceptions. Reforestation is an improvement to the underlying land both for appraisal and most tax purposes. Cost of reforestation typically ranges from $250 to $350 per acre for acres actually reforested, varying with location, site conditions, stocking density, size and species of seedlings or transplants, and project size. Whether the purchaser or seller of the timber pays this cost should be stipulated contractually.

*Further, fire protection and slash disposal cost shown assumes ordinary forest practices abatement and excludes costs of off-site debris hauling, slash chipping, stump pulling or grinding and disposal, land grading, buffer barricading, and also excludes costs of tree marking, reforestation, permit fees, real estate excise tax or business and occupation tax, and sales fees (if any) that may be incurred in procuring or harvesting the timber.

Truck haul – Volume in MBF:

		Destination					
Species	MBF	Tumwater/ Olympia	Kamilche	Belfair	Shelton/ Tacoma	Fredrickson	Centralia
Douglas fir	138	71	-	6	43	18	-
Hemlock	13	-	-	1	5	7	-
Red cedar	24	-	24	-	-	-	-
Alder	22	13	-	-	-	-	9
Totals:	197	84	24	7	48	25	9
Pct. of total:		43%	12%	4%	24%	13%	4%

Number of miles to log destinations on Class A roads: Tumwater/Olympia 76; Kamilche 62; Belfair 29; Shelton/Tacoma 55; Fredrickson 66; Centralia 95.

Average Class A mileage weighted by board foot volume to respective destinations: 66.9. Average mileage on Class C roads: 0.1.

Truckers customarily charge commercial clients for log haul at a rate averaging $6 to $8 per mile per load on Class A roads at the date of value (upper end of price range for short hauling distances); approximately $12 per mile on Class C roads. Varying by load capacity and log size, total board footage per load typically ranges between approximately 3,300 board feet on loads with smaller sized logs to 5,600 board feet per load in hauling larger sized logs. On particular loads, board footage may occur outside of this range. Sources of rates and load estimates: survey of and feedback from truckers, loggers and permitted users of prior appraisals. Average quantity per load on this parcel: 4,700 board feet. Average log haul cost per MBF: [($7.25 / 4.7 MBF) x 66.9 Class A miles] + [($12 / 4.7 MBF)] x 0.1 Class C miles = $103 per MBF.

Washington State timber excise tax (WAC 458-40; 2nd half 2018): Stumpage Value Area 4, Haul Zone 1; volume per acre adjustment: $-15; logging conditions adjustment: $-0; "chipwood" (pulp) unadjusted per WAC 458-40-660(3)(a). Notes: State of Washington Department of Revenue established the stumpage rates per MBF stated below during the months prior to the six-month period to which they apply for the purpose of calculating timber excise tax based on Class IV-General harvest; also applies proportionately to a Class III harvest at tax rate of 4.2%:

Species			Rate
Douglas fir	132	@	$601
Hemlock	12		386
Red cedar	21		1,299
Alder	9		611
Chipwood	23		117
Total	197		X $606 x 5.0% = $30/M

Indication of Contributory Merchantable Timber Value as of August 7, 2018, under a Class IV-General Forest Practice

	Delivered Log Value	Logging Cost	Stumpage Value Sub-totals
Douglas fir	[(138M @ $837) = $115,506]	- [(138M @ $286) = $39,468]) =	$76,038
Hemlock	[(13M @ $656) = $8,528]	- [(13M @ $286) = $3,718]) =	4,810
Red cedar	[(24M @ $1,280) = $30,720]	- [(24M @ $286) = $6,864]) =	23,856
Alder	[(22M @ $514) = $11,308]	- [(22M @ $286) = $6,292) =	5,016
	Total Delivered Log Value: $166,062	Total Logging Cost: $56,342	
	Rounded to: $166,000	Total Unadjusted Stumpage Value:	$109,720
		Value contribution @ 85%:	**$93,000**

Indicated estimate of value contribution adjusts for marketing and management costs; prospective time lag to receipt of timber or log sale proceeds; risk and profit to landowner in resale of timber commodity; and appraisal principle of conforming use.

PART IV - SUPPLEMENTAL EXHIBITS AND ADDENDA

ADDENDUM A:
Timber Statement of Work (Engagement Instructions);
Title Report dated January 30, 2018

This page intentionally left blank

Appraisal and Appraisal Review Services
Forest Practices Consulting, Timber Cruising and Marketing Established 1946

S. A. NEWMAN FIRM
(incorporated as S.A. Newman, Forest Engineers, Inc.)

Offices: 3216 Wetmore Avenue, Suite 205, Everett, WA 98201-4368
Mail: P. O. Box 156, Everett WA 98206-0156
Phone 425-259-4411; Facsimile 425-258-4435
Web: www.sanforest.com

CONFIDENTIAL July 25, 2018

Via email: gary-lyman@comcast.net
Mr. Gary D. Lyman, MAI, President
Richards & Associates
908 Bertha Avenue
Bremerton, WA 98312

Re: Scope of work/fee quote to cruise and appraise timber on property owned by Arness Tree Farms Inc., a Washington corporation; parcel 062602-1-018-2006

Dear Mr. Lyman:

You request a scope of work and fee quote to cruise and appraise merchantable timber on part the tax parcel referenced above. The "whole property" is legally described as that portion of Section 6, Township 26 North, Range 2 East, W.M., Kitsap County, Washington, described as Parcel II in Exhibit "A" of that title report dated January 30, 2018 issued by Pacific Northwest Title; order no. 32163844. Land area totals approximately 81.86 acres [assessor records]. Area proposed to be acquired consists of an approximately 14-acre subunit thereof as mapped on the attachment. Although subject to your determination, the "larger parcel" as defined for appraisal purposes potentially encompasses the entire contiguous ownership. Proposed acquisition area includes certain mapped wetland. Creeks rated as fish bearing occupy part of the whole property but are not believed to be part of acquisition area.

Scope of work. The cruise is an estimate of volume (in thousands of board feet) and grade for each species of merchantable timber; grading standards of Northwest Log Scaling & Grading Bureau and export sorts where applicable. Scope of cruising relates exclusively to timber within proposed acquisition area: this subunit will, however, be recognized as part of a larger "whole property" for the purpose of estimating unit log values and logging cost and efficiencies of the larger scale. Subject to findings about estimated number of merchantable stand acres, minimum proposed cruise intensity is one variable radius plot per 0.8 acre, applied to stands projected as both merchantable-sized and legally harvestable under a Class IV-General forest practice, i.e., up to approximately 16 variable radius plots. At least two-thirds of all trees on the indicated plots shall be fully measured and graded; remaining trees tallied

by species and diameter only. Grid layout for installation of plots to be equidistant or otherwise stratified within cruised stands.

The appraisal of on-site merchantable timber will estimate itemized logging costs per MBF (including hauling cost/log destination analysis for competing buyers), log values for each grade, and contributory timber value by a conversion return method (variant of income approach)—again, recognizing that the proposed acquisition area is part of a larger commercial unit. Merchantable timber on this property will at your request be valued exclusively under the harvest premise of a Class IV-General forest practice (with near term land use conversion). Therefore, cruise plots will not be installed within forested wetland, on which Kitsap County typically does not permit harvest under this class of forest practice. Timber will be valued to an export unrestricted log market as of a current date. Scope of work includes projection of yield and market discount rates if and to the extent that on-site timber is sub-merchantable or pre-merchantable. A fee simple estate in on-site timber will be valued in conformance with *Uniform Standards of Professional Appraisal Practice* (USPAP) when used with report of lead property appraiser. These data will be presented under one cover.

Permitted users; function. This cruise and timber appraisal shall be prepared for the sole and exclusive use of our firm's prospective client Richards & Associates and its lead property appraiser Gary D. Lyman, MAI and the firm's client Kitsap County. The sole function of the cruise and timber appraisal is to assist in establishing the market value contribution of the proposed acquisition area in order to establish a purchase offer by your client in a voluntary transaction.

Fee; performance period. Our firm's fee to Richards & Associates to field examine this timber and perform cruising and timber appraisal services, payable on delivery of the report, is as follows:

Cruise on-site timber:
Appraise on-site merch. timber—
Class IV-General: _____
Total

Reasonable efforts will be exercised to complete and deliver our findings to you within thirty-five (35) calendar days after notice to proceed. Please advise of any earlier or specific deadline. A locked color pdf will be emailed to you upon completion: a hard copy or copies will also be provided if you so request.

To authorize, please acknowledge by return mail with authorizing signature on the line below or by return email. Any additional file information that might be relevant in estimating market value is also requested if available. A permit to inspect the site is assumed to have been procured if and upon receipt of authorization to proceed. Details on entry protocol (contact person, phone no. or email address) are, however, appreciated.

You are welcome to include this timber scope of work as part your submittal to Kitsap County. Please feel free to contact me if you have any questions. Thank you.

Very truly yours,
S. A. NEWMAN FIRM

Timothy D. Newman, MAI, CF
Partner
WA State Certified-General Appraiser 1100664
Certification expires Feb. 27, 2019
Email: tnewman@sanforest.com

Engagement terms accepted:

By _____ Dated: 7/30/18
Gary D. Lyman, MAI

Attachments:
Proposed acquisition area (perimeter in yellow)
CV

This page intentionally left blank

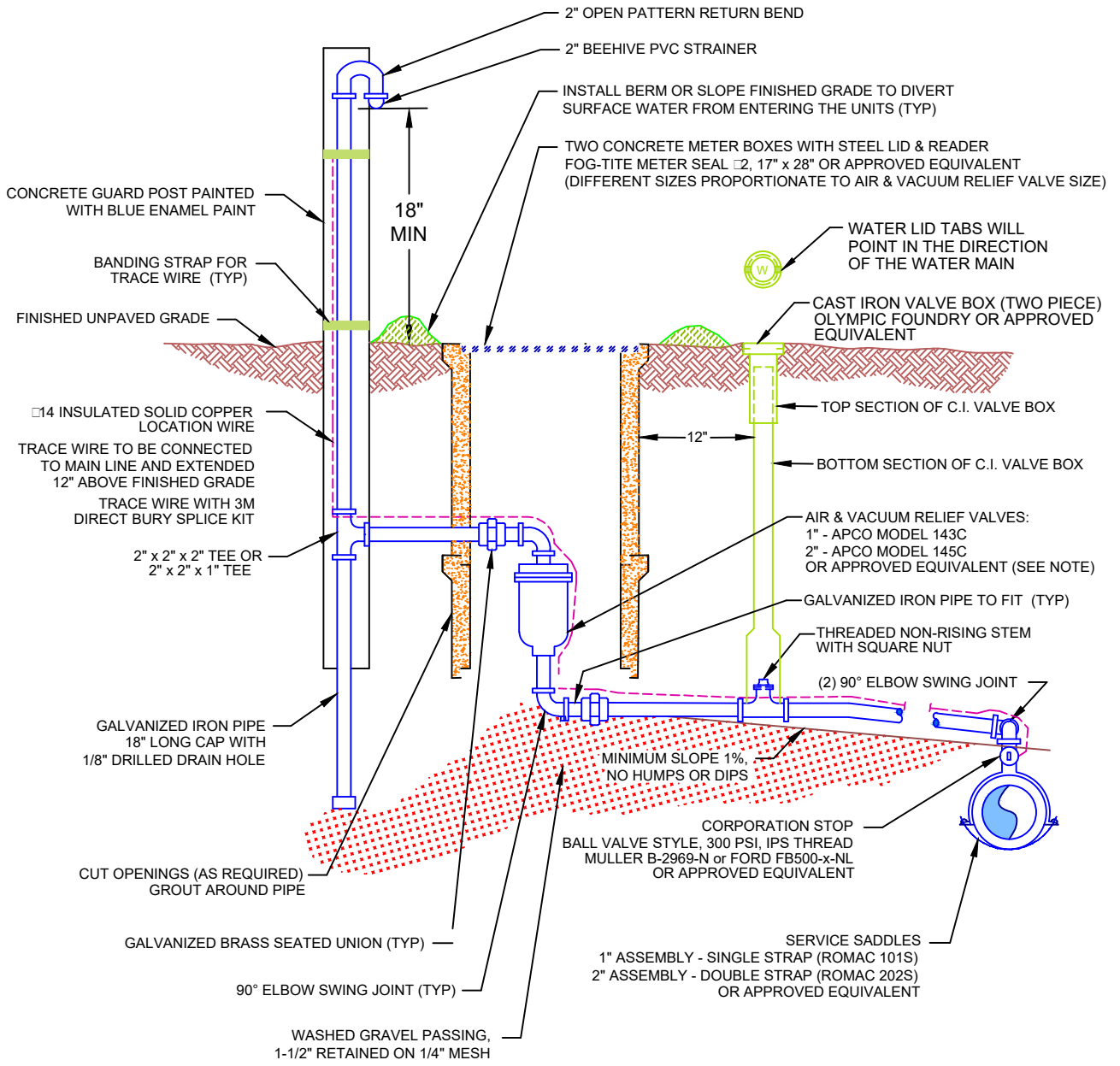
Appendix F

Kitsap Public Utility District Standard Plans

This page intentionally left blank

NOTES:

1. AIR & VACUUM RELIEF VALVE ASSEMBLY MUST BE INSTALLED AT HIGHEST POINT OF LINE. IF A HIGH POINT FALLS IN A LOCATION WHERE ASSEMBLY CANNOT BE INSTALLED, PROVIDE ADDITIONAL DEPTH OF LINE TO CREATE A HIGH POINT AT A LOCATION, WHERE ASSEMBLY CAN BE INSTALLED.
2. ALL PIPE AND FITTINGS SHALL BE GALVANIZED IRON.

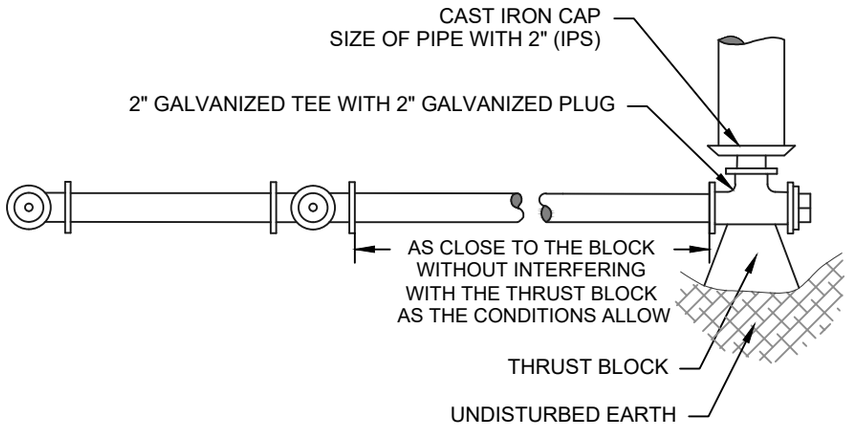


KPUD CONNECTING KITSAP

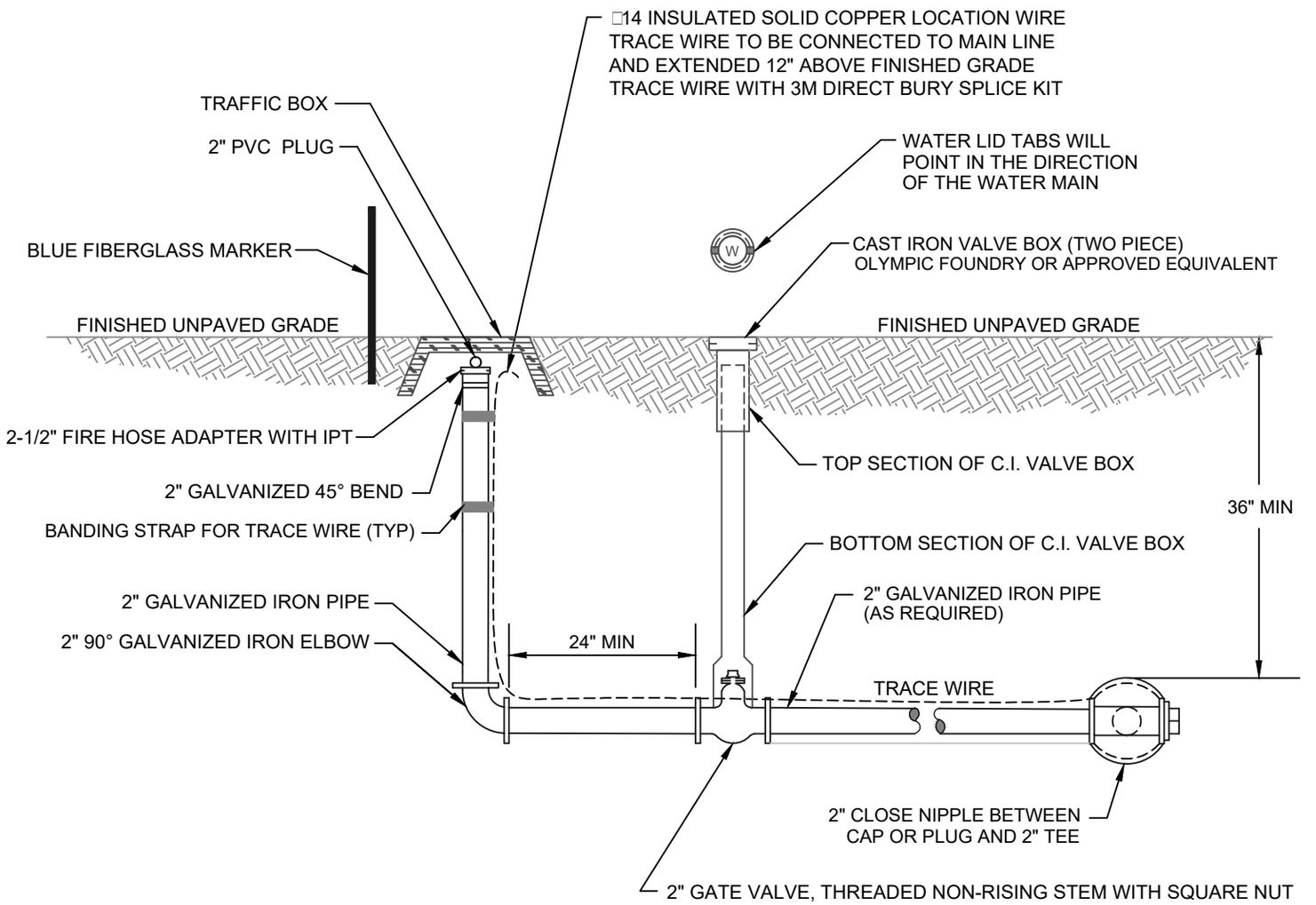
CONTACT INFORMATION
Kitsap PUD
PO Box 1989
Poulsbo WA 98370
Tel: 360-779-7656
Fax: 360-779-3284
Web: www.kpud.org

AIR & AIR-VACUUM RELIEF VALVE ASSEMBLY

FILE NAME: SD W-1 A&AV-RVA.DWG	
DRAWN BY: KSE	REVISIONS: WHW
SCALE: NONE	REVISION: 2
STANDARD DETAIL: W-1	DATE: 10/9/2020



PLAN VIEW



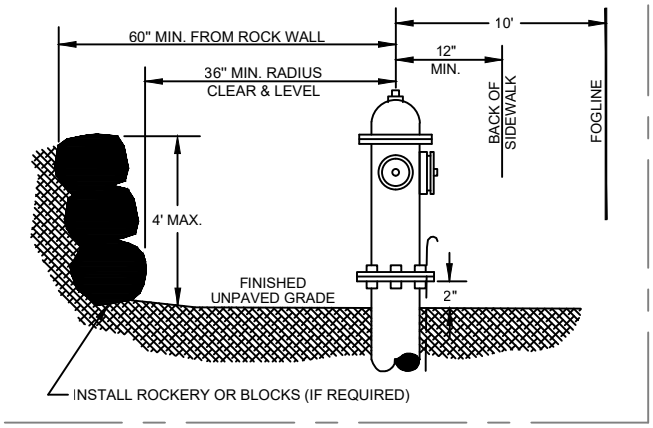
ELEVATION VIEW

KPUD
CONNECTING KITSAP

CONTACT INFORMATION
Kitsap PUD
PO Box 1989
Poulsbo WA 98370
Tel: 360-779-7656
Fax: 360-779-3284
Web: www.kpud.org

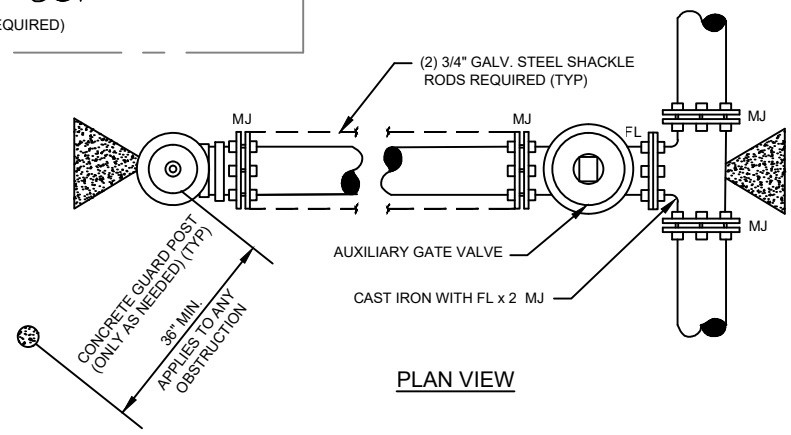
2" BLOW-OFF ASSEMBLY

FILE NAME: SD W-2 BOA.DWG	
DRAWN BY: KSE	REVISIONS: KSE
SCALE: NONE	REVISION: 1
STANDARD DETAIL: W-2	DATE: 02/12/2018

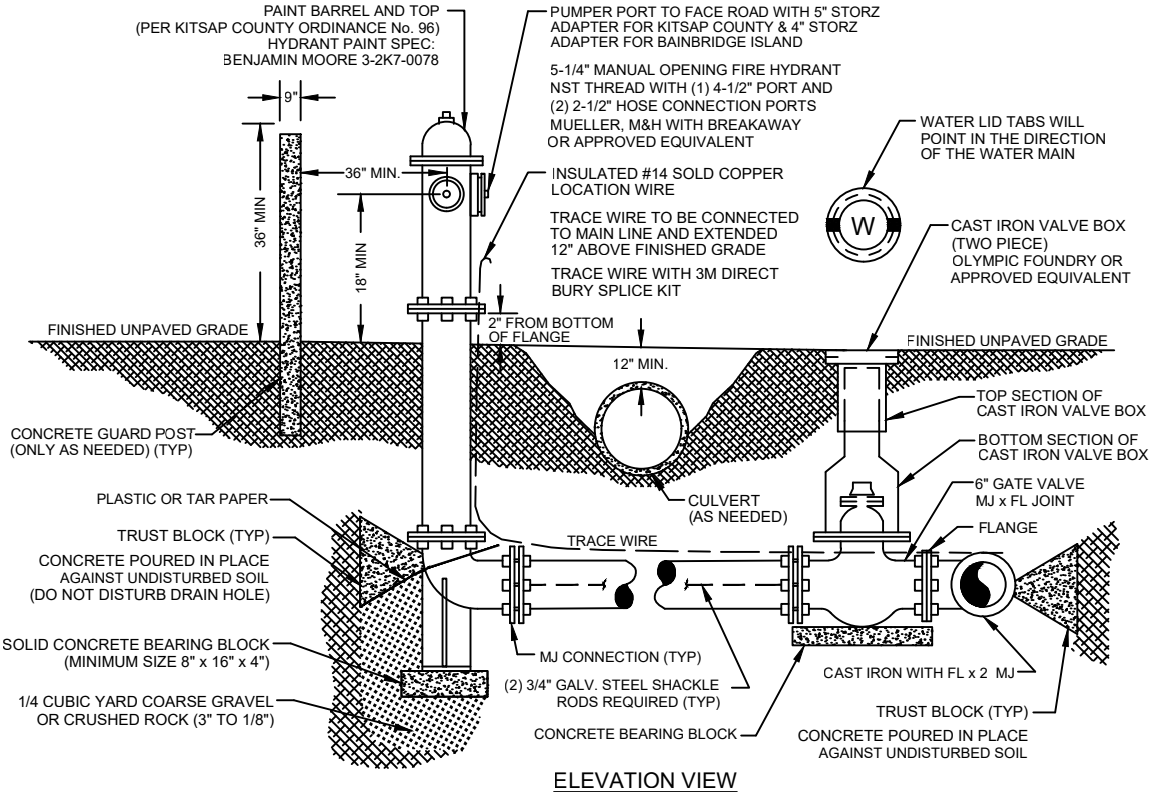


NOTES:

1. FIRE HYDRANTS WILL BE DOUBLE RESTRAINED; USING TWO OF THREE FORMS OF RESTRAINT BETWEEN AUXILIARY VALVE & HYDRANT ASSEMBLY.
2. MEGA LUGS POURED IN PLACE, CONCRETE THRUST BLOCK, 3/4" GALVANIZED SHACKLE RODS MAY BE REQUIRED (DEPENDING ON CONDITIONS).
3. REGARDLESS OF RESTRAINT METHOD, THERE WILL BE A POURED CONCRETE THRUST BLOCK BEHIND HYDRANT TEE. IF HYDRANT RUNS LONGER THAN ONE LENGTH OF PIPE, FIELD LOCK GASKETS WILL BE REQUIRED.
4. PROVIDE LEVEL ACCESS TO FIRE HYDRANT.
5. FIRE HYDRANT TO BE SET BACK 10' FROM FOGLINE, UNLESS REDUCTION APPROVED BY THE ENGINEER.



PLAN VIEW



ELEVATION VIEW

KPUD CONNECTING KITSAP

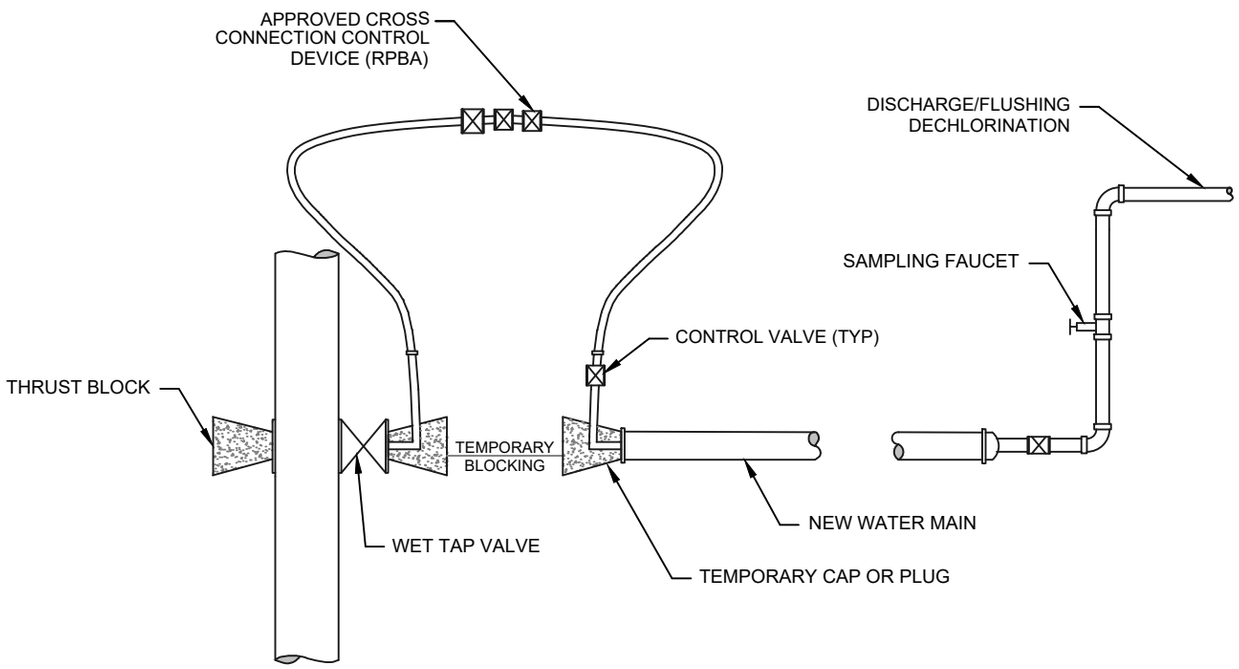
CONTACT INFORMATION
Kitsap PUD
PO Box 1989
Poulsbo WA 98370
Tel: 360-779-7656
Fax: 360-779-3284
Web: www.kpud.org

FIRE HYDRANT ASSEMBLY

FILE NAME: SD W-4 FHA.DWG	
DRAWN BY: KSE	REVISION: WHW
SCALE: NONE	REVISION: 2
STANDARD DETAIL: W-4	DATE: 067/2022

NOTES:

1. STAYING IN COMPLIANCE WITH D.O.H.'S EMPHASIS ON CROSS CONNECTIONS, A PHYSICAL SEPARATION BETWEEN THE EXISTING WATER MAIN AND ANY NEW EXTENSIONS, WILL BE MAINTAINED DURING THE COURSE OF CONSTRUCTION. THE INITIAL FILLING AND FLUSHING, WILL BE DONE THROUGH A REDUCED PRESSURE BACKFLOW ASSEMBLY (RPBA).
2. PUT A BLIND FLANGE/CAP WITH A 2" TAP WITH A STANDPIPE.
3. 5' TO 8' FROM THE TAP VALVE, LAY THE FIRST PIPE WITH A BLIND FLANGE/CAP OR PLUG WITH A 2" TAP AND STANDPIPE.
4. WHEN THE CONSTRUCTION OF THE MAIN IS DONE, FILL THE NEW MAIN USING HOSES AND REDUCED PRESSURE BACKFLOW ASSEMBLY (RPBA).
5. FLUSH CHLORINATED WATER USING THE REDUCED PRESSURE BACKFLOW ASSEMBLY (RPBA).
6. BACTI SAMPLES
7. HYDROSTATIC TEST
8. MAKE FINAL CONNECTION, SWABBING ALL PARTS AND PIPE WITH CHLORINE SOLUTION. (□INSPECTOR MUST BE PRESENT□)
9. AFTER FINAL CONNECTION, PERFORM DEBRIS FLUSH.



KPUD CONNECTING KITSAP

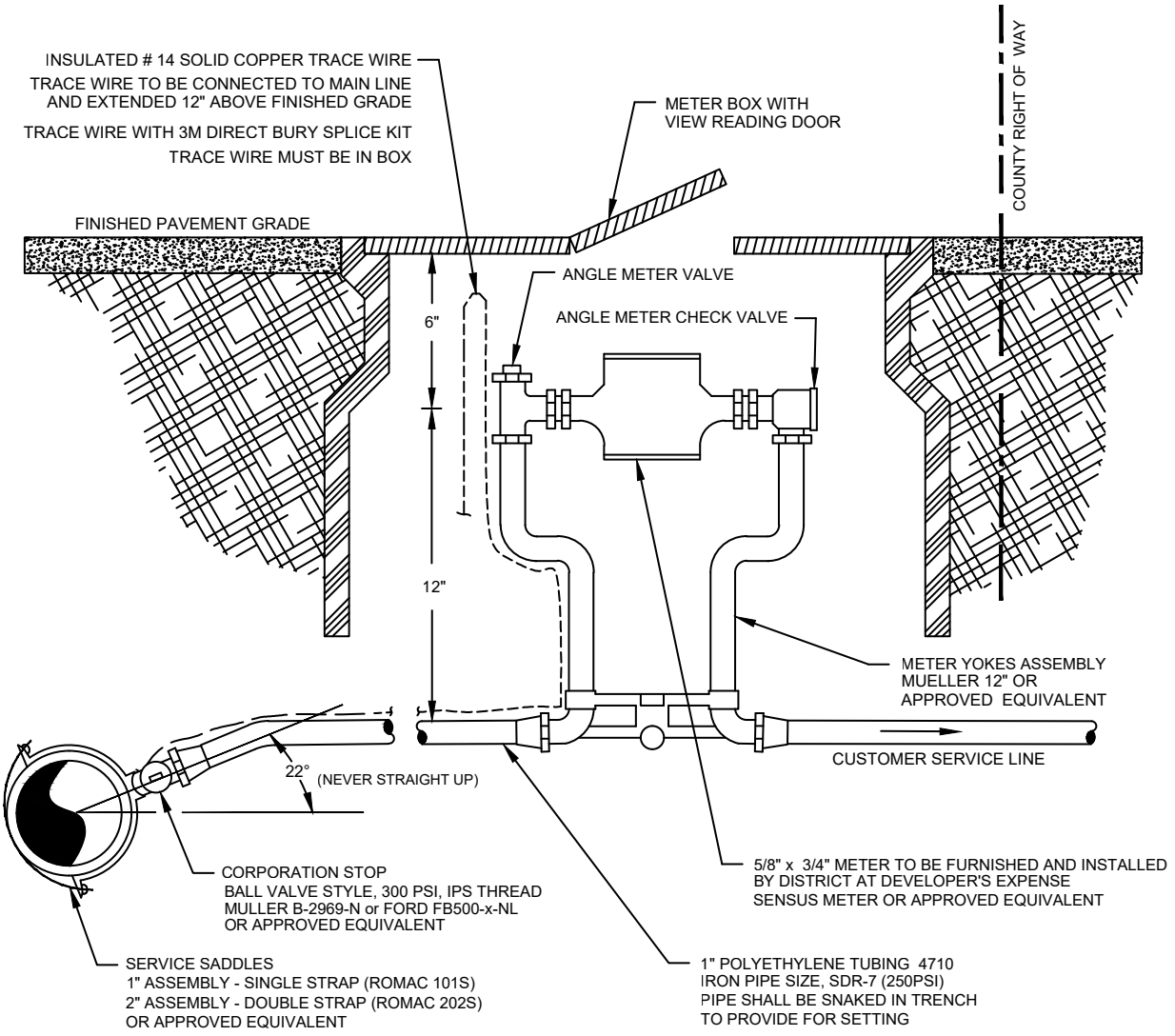
CONTACT INFORMATION
Kitsap PUD
PO Box 1989
Poulsbo WA 98370
Tel: 360-779-7656
Fax: 360-779-3284
Web: www.kpud.org

NEW WATER MAIN SEPARATION

FILE NAME: SD W-8 NWMS.DWG	
DRAWN BY: KSE	REVISIONS: KSE
SCALE: NONE	REVISION: 0
STANDARD DETAIL: W-8	DATE: 02/12/2018

NOTES:

1. THE DISTRICT'S RESPONSIBILITY "ENDS" AT THE METER BOX.
2. PROPERTIES THAT HAVE PLANS FOR HOUSE FIRE SPRINKLERS, MUST BE SINGLE SERVICE CONNECTIONS WITH 1" SETTERS.
3. TRAFFIC LOCATIONS:
   CARSON MSBCF 1118-12 PLASTIC BOX OR EQUIVALENT, DUCTILE IRON LID WITH VIEW READING DOOR FOR NON-PRV APPLICATIONS.
   CARSON MSBCF 1324-12 PLASTIC BOX OR EQUIVALENT, DUCTILE IRON LID WITH METER READING LID FOR PRV APPLICATIONS.
   METER BOXES MUST HAVE A 1-3/4" DRILLED HOLE IN A CORNER OR TOUCH PAD ADAPTOR (NOT TO INTERFERE WITH METER OR PRV).
4. NON-TRAFFIC LOCATIONS:
   CARSON 1419-12 PLASTIC BOX OR EQUIVALENT, PLASTIC LID WITH METER READING DOOR FOR PRV & NON PRV APPLICATIONS.
   METER BOXES MUST HAVE A 1-3/4" DRILLED HOLE IN A CORNER OR TOUCH PAD ADAPTOR (NOT TO INTERFERE WITH METER OR PRV).



KPUD CONNECTING KITSAP

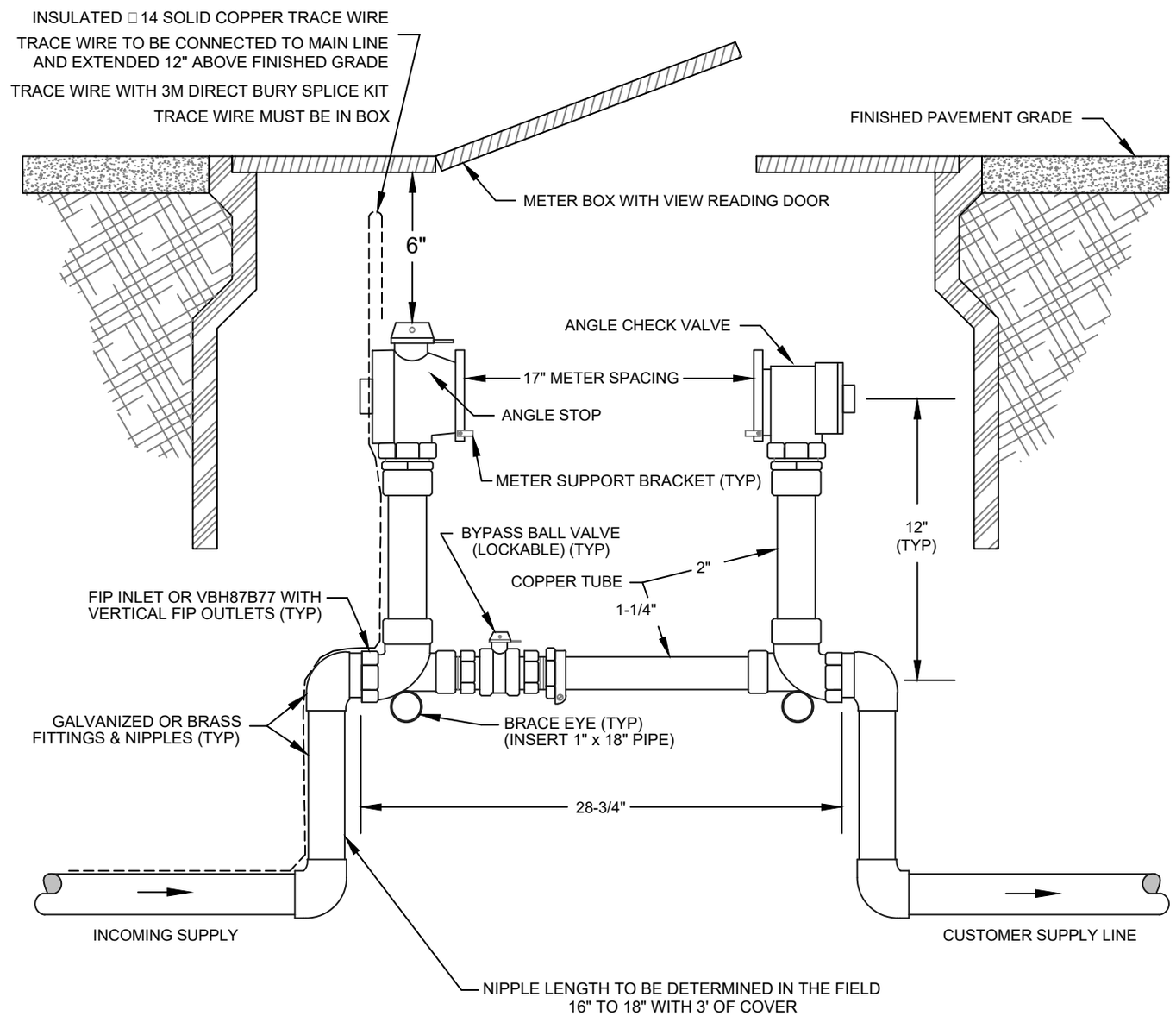
CONTACT INFORMATION
Kitsap PUD
PO Box 1989
Poulsbo WA 98370
Tel: 360-779-7656
Fax: 360-779-3284
Web: www.kpud.org

SINGLE SERVICE CONNECTION
5/8" - 1"

FILE NAME: SD W-12 SSC.DWG	
DRAWN BY: KSE	REVISION: WHW
SCALE: NONE	REVISION: 3
STANDARD DETAIL: W-12	DATE: 6/7/2022

NOTES:

1. THE DISTRICT'S RESPONSIBILITY "ENDS" AT THE METER BOX
2. METER BOXES 1-1/2" AND 2" METER YOKES
3. TRAFFIC LOCATIONS:
   CARSON MSBCF 1730-18 PLASTIC BOX OR APPROVED EQUIVALENT
   DUCTILE IRON LID WITH A VIEW READING DOOR
   METER BOXES MUST HAVE A 1-3/4" DRILLED HOLE IN A CORNER (NOT TO INTERFERE WITH METER OR PRV)
4. NON-TRAFFIC LOCATIONS:
   CARSON 1730-18 PLASTIC BOX OR APPROVED EQUIVALENT
   PLASTIC LID WITH A VIEW READING DOOR
   METER BOXES MUST HAVE A 1-3/4" DRILLED HOLE IN A CORNER (NOT TO INTERFERE WITH METER OR PRV)
   NON-BOLT DOWN OR APPROVED EQUIVALENT

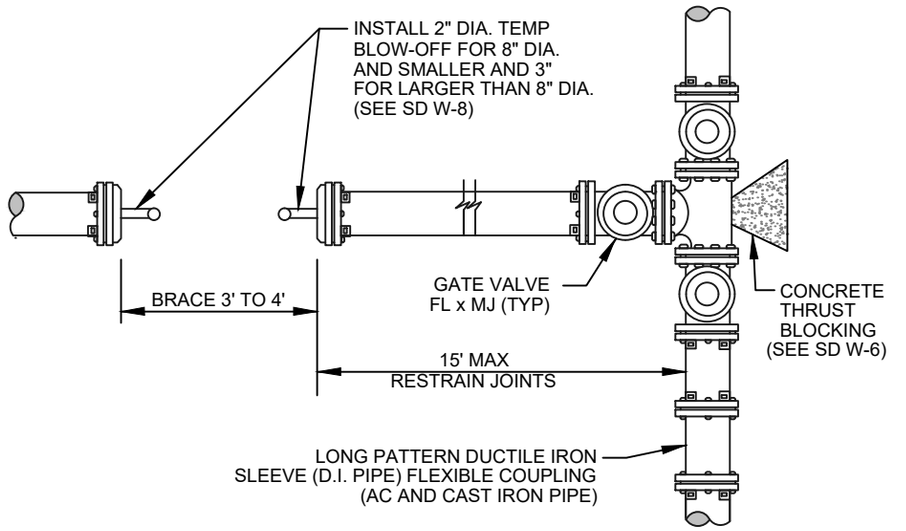


KPUD CONNECTING KITSAP

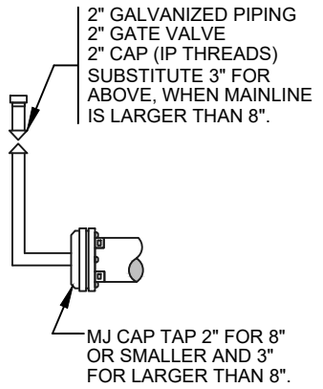
CONTACT INFORMATION
Kitsap PUD
PO Box 1989
Poulsbo WA 98370
Tel: 360-779-7656
Fax: 360-779-3284
Web: www.kpud.org

1-1/2" & 2" METER YOKE

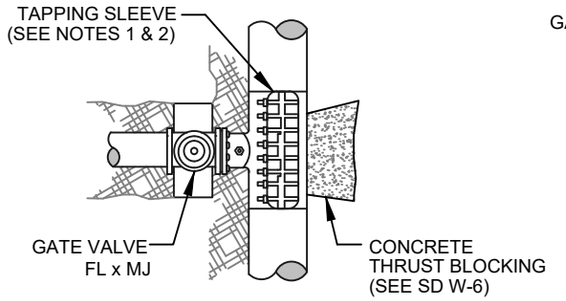
FILE NAME: SD W-13 MTR YOKE.DWG	
DRAWN BY: KSE	REVISIONS: KSE
SCALE: NONE	REVISION: 1
STANDARD DETAIL: W-13	DATE: 02/12/2018

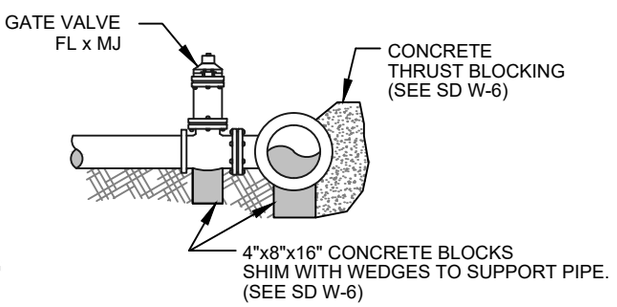


CUT-IN CONNECTION



TEMP BLOW-OFF





TAPPED CONNECTION

NOTES:

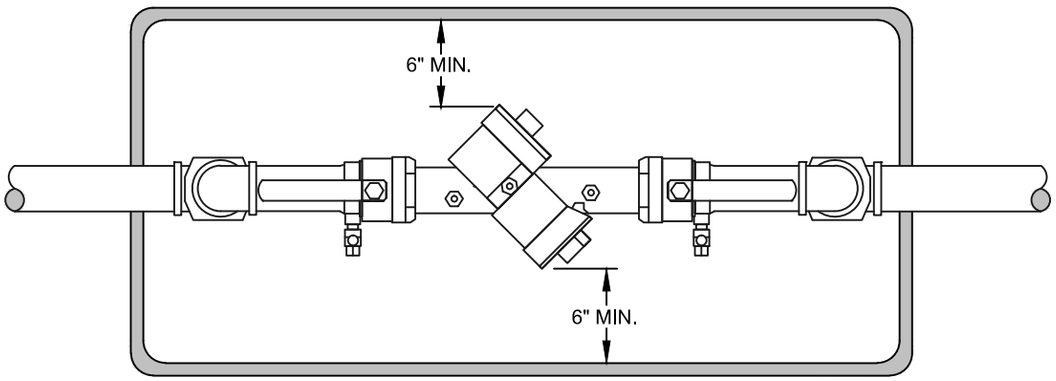
1. TAPPED CONNECTIONS NOT ALLOWED WITHOUT SPECIFIC APPROVAL FROM KITSAP PUD.
2. NO CONNECTION WILL BE ALLOWED UNTIL ALL PRESSURE TESTING COMPLETED, AND SATISFACTORY BACTERIOLOGICAL TEST RECEIVED. SEE CROSS CONNECTION CONTROL IN STANDARD DETAIL W-23.
3. TAPPING SLEEVE TO BE STAINLESS STEEL FOR AC PIPE AND EPOXY COATED STEEL FOR DUCTILE OR CAST IRON PIPE. CLOSEST EDGE OF TAPPING SLEEVE MUST BE 3' (MIN.) FROM COUPLING ON AC PIPE.
4. SEE STANDARD DETAIL W-9 (VALVE BOX) AND STANDARD DETAIL W-6 (THRUST BLOCKING). PIPE AND FITTING RESTRAINTS MAY VARY.
5. BACKFILL PER JURISDICTIONAL REQUIREMENTS WHEN IN ASPHALT. ALL OTHER AREAS PER STANDARD DETAIL SPECIFICATIONS.
6. TEMP BLOW-OFF'S MUST BE PROTECTED FROM DAMAGE. PLACE IN TRAFFIC BOX IF REQUIRED.
7. ALL MJ JOINTS TO BE MEGA LUG OR EQUAL.
8. SIMILAR TEMP BLOW-OFF REQUIREMENTS FOR TAPPED CONNECTIONS. LOCATE BLOW-OFF OUT OF ASPHALT WHEN POSSIBLE.
9. ALL FITTINGS AND PIPE SHALL BE STERILE SWABBED. CONNECTION SHALL BE INSPECTED FOR VISUAL LEAKAGE UNDER FULL LINE PRESSURE PRIOR TO BACKFILL.

KPUD CONNECTING KITSAP

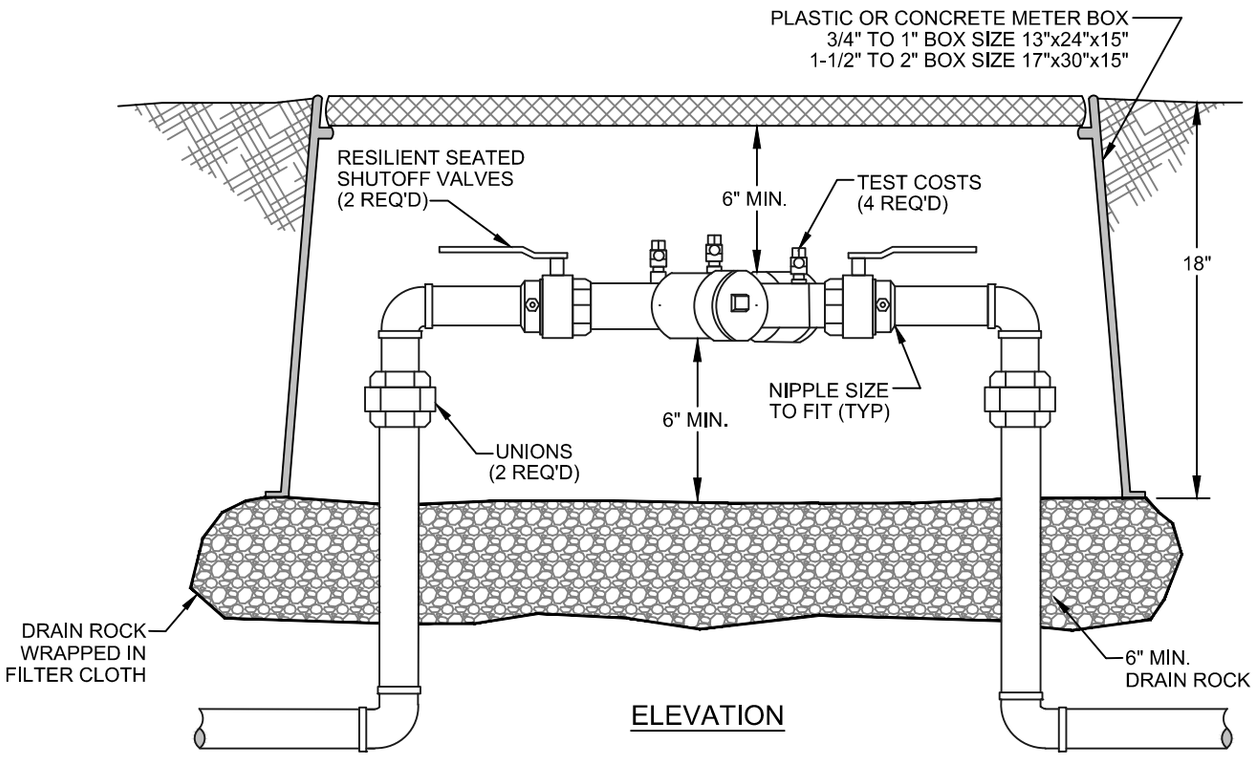
CONTACT INFORMATION
Kitsap PUD
PO Box 1989
Poulsbo WA 98370
Tel: 360-779-7656
Fax: 360-779-3284
Web: www.kpud.org

CONNECTION REQUIREMENT

FILE NAME: SD W-17 CR.DWG	
DRAWN BY: KSE	REVISIONS: KSE
SCALE: NONE	REVISION: 0
STANDARD DETAIL: W-17	DATE: 02/12/2018



PLAN



ELEVATION

NOTES:

1. DOUBLE CHECK VALVE ASSEMBLY (DCVA) WILL BE WASHINGTON STATE DEPARTMENT OF HEALTH APPROVED.
2. DCVA MUST INCLUDE (2) RESILIENT SEATED SHUT OFF VALVES & (4) RESILIENT SEATED TEST-COCKS WITH PLUGS INSTALLED AND (2) UNIONS.
3. 2" AND SMALLER DCVA IN (2) METER BOXES STACKED ON TOP OF EACH OTHER OR BOX WHEN NEEDED. (MUST HAVE A REMOVABLE COVER).
4. 4" MINIMUM AND 12" MAXIMUM DISTANCE BETWEEN UNDERSIDE OF LID AND HIGHEST POINT OF DEVICE.
5. DRAIN ROCK MUST BE A MINIMUM OF 12" DEEP AT THE BOTTOM OF THE BOX.
6. MINIMUM DISTANCE OF 4" - 6" BETWEEN LOWEST POINT OF DEVICE AND DRAIN ROCK.
7. Y-PATTERN DCVA SHOULD BE INSTALLED ON SIDE. WHEN TEST COCKS ARE FACING SIDEWAYS, THERE MUST BE A MINIMUM OF 6" CLEARANCE BETWEEN TEST COCKS AND THE SIDE OF THE BOX.
8. TEST DCVA BEFORE USE AND SEND REPORT TO KITSAP PUBLIC UTILITY DISTRICT FOR APPROVAL.

KPUD
CONNECTING KITSAP

CONTACT INFORMATION
Kitsap PUD
PO Box 1989
Poulsbo WA 98370
Tel: 360-779-7656
Fax: 360-779-3284
Web: www.kpud.org

DOUBLE CHECK VALVE ASSEMBLY 2 INCH AND SMALLER

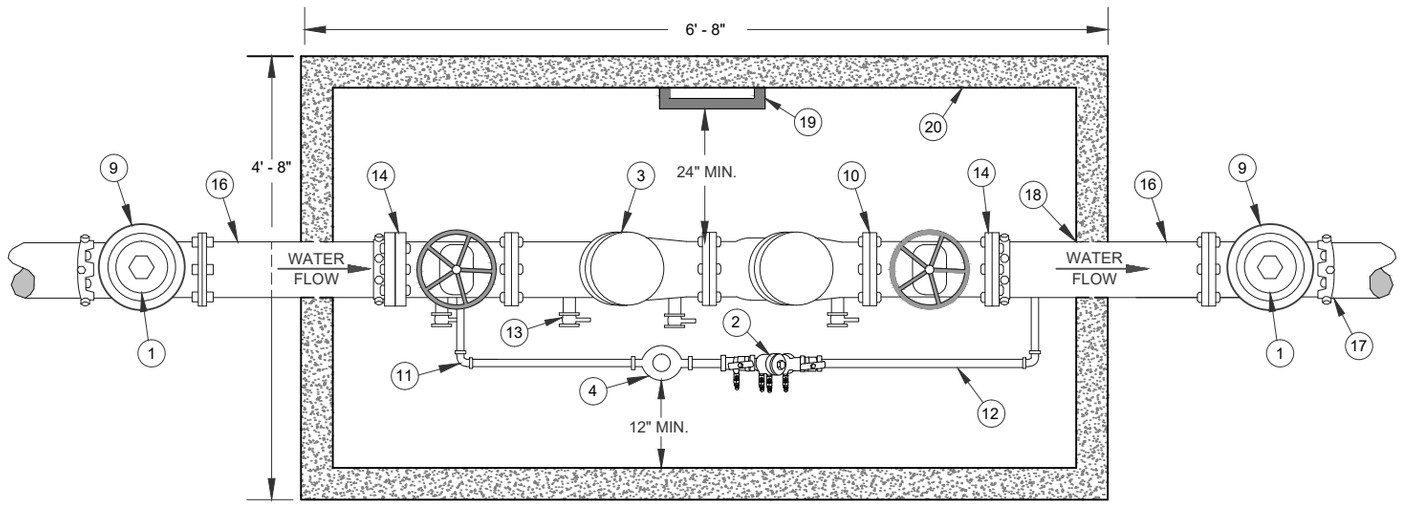
FILE NAME: SD W-18 DCVA-2 INCH&SMLR.DWG	
DRAWN BY: COBI	REVISIONS: KSE
SCALE: NONE	REVISION: 1
STANDARD DETAIL: W-18	DATE: 02/12/2018

MATERIAL LIST:

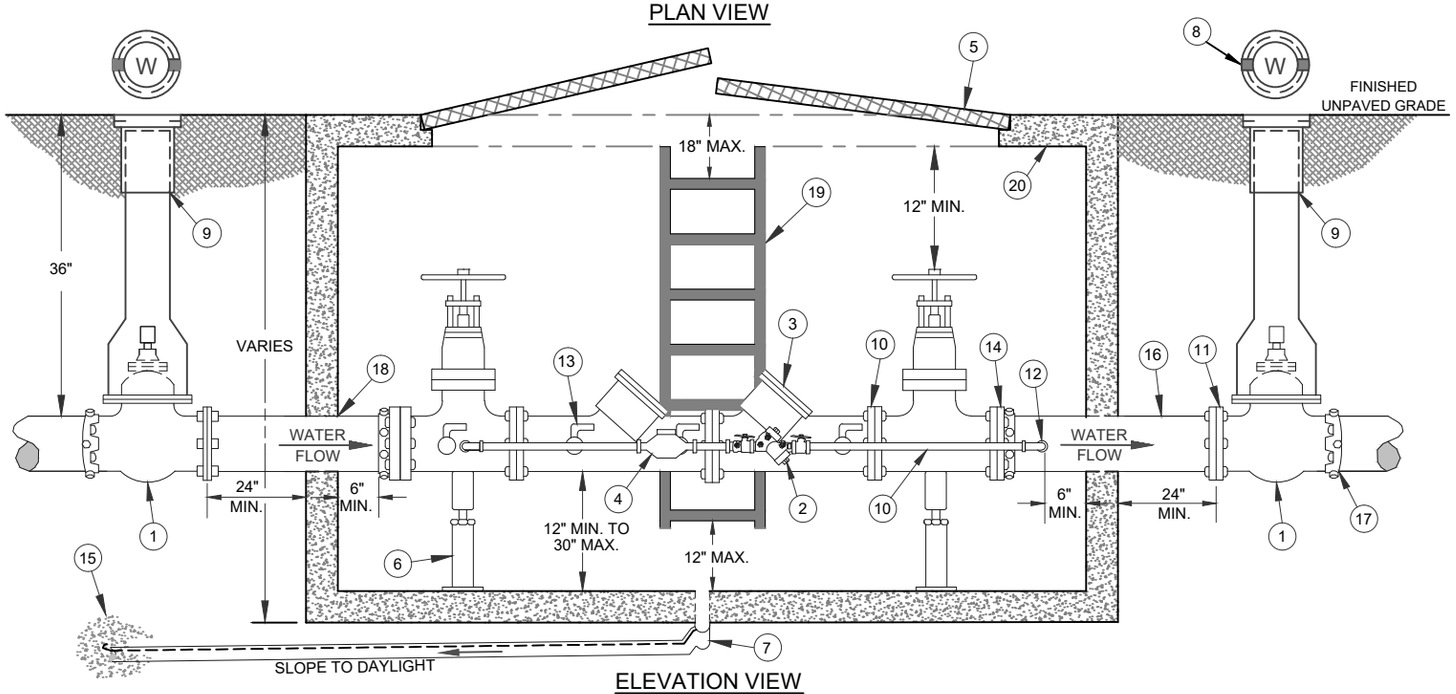
1. (2) MAIN GATE VALVES, RESILIENT SEATED. (SIZE VARIED BY ENGINEER)
2. 3/4" DOUBLE CHECK VALVE ASSEMBLY CONFORMED TO AWWA STANDARDS.
3. DOUBLE DETECTOR CHECK CHECK ASSEMBLY CONFORMED TO AWWA STANDARDS.
4. 5/8" x 3/4" DOMESTIC METER, 1 TO 20 GPM. (READS IN CUBIC FEET)
5. (2) 36" x 36" GALVANIZED STEEL DIAMOND PLATES WITH SPRINGS LOCKING LATCH WITH BOLT FULL SWING-OPEN 180° HATCH.
6. (2) NON-CORROSIVE SUPPORT FOR DEVICES 2-1/2" OR LARGER (MUST BE APPROVED BY THE DISTRICT).
7. 4" FLOOR DRAIN WITH A TRACE WIRE. IF DRAIN CANNOT BE SLOPED TO DAYLIGHT OR INFILTRATION PIT, A SUMP PUMP MUST BE INSTALLED.
8. (2) WATER LIDS (TABS WILL POINT IN THE DIRECTION OF THE WATER MAIN)
9. (2) CAST IRON VALVE BOXES (TWO PIECE - TOP & BOTTOM) OLYMPIC FOUNDRY OR APPROVED EQUIVALENT.
10. FLANGE (TYP)
11. (2) 90° ELBOWS
12. 3/4" BRASS PIPE - BYPASS
13. (4) 3/4" BALL VALVES - TEST COCKS
14. (2) FLANGE COUPLING ASSEMBLY
15. (1) CUBIC YARD OF WASHED GRAVEL
16. DUCTILE IRON PIPE (SIZE VARIED, BY AN ENGINEER)
17. MEGA LUG & FIELD LOK GASKETS (100' OR AS REQUIRED OR TIE BACK BLOCK). (TYP)
18. WALL PIPE, FLANGE WITH PLAIN END WITH INTEGRALLY CAST COLLAR.
19. PERMANENT FIXED GALVANIZED STEEL LADDER IN VAULTS OVER 4' DEEP.
20. CONCRETE VAULT

NOTES:

1. ANY FIRE SERVICE VAULTS MUST BE APPROVED BY THE FIRE MARSHALL.
2. 3" PIPING AND ABOVE SHALL BE DUCTILE IRON.
3. CLEARANCES STILL APPLY WHEN DEVICES ARE INSTALLED IN VAULTS.
4. PROVIDE PLUGS ON ALL TEST COCKS.
5. DEVICES MUST BE TESTED UPON INSTALLATION.
6. ALL "MJ" (MECHANICAL JOINT) FITTINGS SHALL BE MEGA LUG.
7. VAULT LOCATION SHOWN IS IN A LANDSCAPED OR UNIMPROVED AREA. (□INSTALLATION IN ASPHALT SHALL "NOT" BE ALLOWED, WITHOUT PRIOR APPROVAL□).
8. CONCRETE VAULT EQUAL TO HANSON PIPE PRECAST INC. OR UTILITY VAULT COMPANY. (OLD CASTLE PRECAST)



PLAN VIEW



ELEVATION VIEW

KPUD CONNECTING KITSAP

CONTACT INFORMATION

Kitsap PUD
PO Box 1989
Poulsbo WA 98370

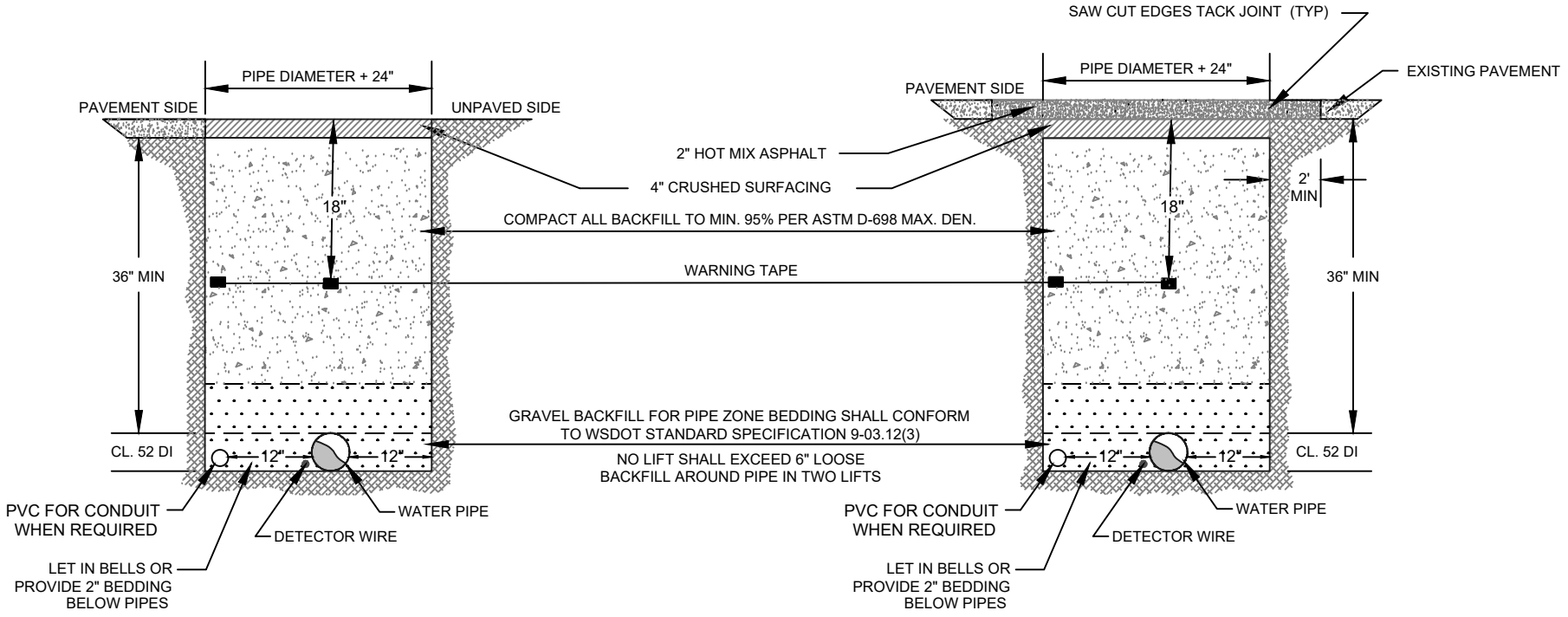
Tel: 360-779-7656
Fax: 360-779-3284
Web: www.kpud.org

DOUBLE CHECK DETECTOR VALVE ASSEMBLY

FILE NAME: SD W-20 DCDVA.DWG	
DRAWN BY: KSE	REVISIONS: KSE
SCALE: NONE	REVISION: 1
STANDARD DETAIL: W-20	DATE: 02/12/2018

NOTE:

1. CONTRACTORS ARE REQUIRED TO MEET ALL WASHINGTON STATE DOT STANDARDS AND KITSAP COUNTY STANDARDS FOR TRENCH AND ASPHALT SURFACING.
2. ASPHALT CONCRETE MIX SHALL BE CLASS "B".
3. ALL UTILITIES SHALL HAVE 36" MIN. COVER UNLESS, OTHERWISE APPROVED BY THE COUNTY ENGINEER.
4. IF ROAD CLOSURES OR DETOURS ARE ANTICIPATED, A TRAFFIC PLAN INCLUDING; SPECIFIC DATES AND DURATIONS OF SUCH ACTIONS SHALL BE FILED WITH THE KITSAP COUNTY DEPARTMENT OF PUBLIC WORKS.
5. THE APPLICANT IS RESPONSIBLE FOR ALL TEMPORARY AND PERMANENT PATCHING.
6. NO OPEN TRENCHES LEFT OVERNIGHT.



ALONG SHOULDER **WITHIN PAVING**

KPUD CONNECTING KITSAP

CONTACT INFORMATION
Kitsap PUD
PO Box 1989
Poulsbo WA 98370
Tel: 360-779-7656
Fax: 360-779-3284
Web: www.kpud.org

TYPICAL STANDARD TRENCH & PAVEMENT RESTORATION WITH OR WITHOUT FIBER CONDUIT

FILE NAME: SD W-30 TST&PR.DWG	
DRAWN BY: KSE	REVISIONS: KSE
SCALE: NONE	REVISION: 2
STANDARD DETAIL: W-30	DATE: 02/12/2018