



**Central Hall Phase 4
2nd Floor Tenant Improvements**

**Attachment A
PROJECT MANUAL
ITB #2026-06**



March 13, 2026

Southern Oregon University
Facilities Management & Planning
351 Walker Avenue • Ashland, Oregon 97520
Phone 541-552-6231
Email mcnamaraj@sou.edu

ATTACHMENT B
PROJECT MANUAL
**CENTRAL HALL
PHASE 4
2nd FLOOR TENANT
IMPROVEMENTS**

SOUTHERN OREGON UNIVERSITY
1250 SISKIYOU BLVD
ASHLAND, OREGON
MARCH 13, 2026

100% CONSTRUCTION DOCUMENTS
FOR BID



PROJECT:	Central Hall Phase 4 Second Floor Tenant Improvements Southern Oregon University 1175 Siskiyou Boulevard Ashland, Oregon 97520
OWNER:	Southern Oregon University 1250 Siskiyou Boulevard Ashland, Oregon 97520
Architect:	KSW Architects, LLC 143 N 1 st Street Ashland, Oregon 97520
HVAC:	ArcSine Engineering 1236 Disc Drive Medford, Oregon 97501
Electrical:	ArcSine Engineering 1236 Disc Drive Medford, Oregon 97501
Plumbing:	ArcSine Engineering 1236 Disc Drive Medford, Oregon 97501

BID DOCUMENTS

Document B-1

Document B-2
Document B-3
Document B-4
Document B-5
Document B-5A
Document B-6
Document B-7
Document B-8
Document B-9
Document B-10

PROCUREMENT + CONTRACTING REQUIREMENTS

SOUTHERN OREGON UNIVERSITY (SOU) STANDARD PUBLIC IMPROVEMENT
CONTRACT – INVITATION TO BID
SOU INSTRUCTIONS TO BIDDERS
SOU SUPPLEMENTAL INSTRUCTIONS TO BIDDERS
Not Used
SOU BID FORM
SOU FIRST TIER SUBCONTRACTOR DISCLOSURE FORM
SOU PUBLIC IMPROVEMENT AGREEMENT FORM
SOU STANDARD CONTRACT PROVISIONS
SOU GENERAL CONDITIONS
SOU PERFORMANCE BOND
SOU PAYMENT BOND

DIVISION 1

Section 011000
Section 012000
Section 012300
Section 012500
Section 012519
Section 012613
Section 013000
Section 013300
Section 013546
Section 014000
Section 015000
Section 016000
Section 017000
Section 017329
Section 017419

GENERAL REQUIREMENTS

SUMMARY
PRICE AND PAYMENT PROCEDURES
ALTERNATES
SUBSTITUTION PROCEDURES
SUBSTITUTION REQUEST FORM
REQUESTS FOR INFORMATION
ADMINISTRATIVE REQUIREMENTS
SUBMITTAL PROCEDURES
INDOOR AIR QUALITY MANAGEMENT
QUALITY REQUIREMENTS
TEMPORARY FACILITIES AND CONTROLS
PRODUCT REQUIREMENTS
EXECUTION REQUIREMENTS
CUTTING AND PATCHING
CONSTRUCTION WASTE MANAGEMENT

DIVISION 2

Section 024119

EXISTING CONDITIONS

SELECTIVE DEMOLITION

DIVISION 3

CONCRETE- Not a part of this manual.

DIVISION 4

MASONRY - Not a part of this manual.

DIVISION 5

Section 055000

METALS

METAL FABRICATIONS

DIVISION 6

Section 060660
Section 061000
Section 062000
Section 064100
Section 066410

WOOD PLASTICS AND COMPOSITES

TRANSLUCENT RESIN PANELS
ROUGH CARPENTRY
FINISH CARPENTRY
ARCHITECTURAL WOOD CASEWORK
FIBERGLASS REINFORCED PANELS

DIVISION 7**THERMAL AND MOISTURE PROTECTION**

Section 072100
Section 079200

INSULATION
JOINT SEALERS

DIVISION 8

Section 081113
Section 081416
Section 087100
Section 088000

OPENINGS

HOLLOW METAL DOORS AND FRAMES
FLUSH WOOD DOORS
DOOR HARDWARE
GLAZING

DIVISION 9

Section 092116
Section 092399
Section 093013
Section 095113
Section 095426
Section 096513
Section 096516
Section 096813
Section 098113
Section 098400
Section 099100

FINISHES

GYPSUM BOARD
GYPSUM PLASTERING
TILING
ACOUSTICAL CEILINGS
SUSPENDED WOOD CEILINGS
RESILIENT BASE
RESILIENT FLOORING
TILE CARPETING
ACOUSTICAL BOARD INSULATION
CEMENTITIOUS WOOD FIBER CEILINGS
PAINTING

DIVISION 10

Section 101101
Section 102113
Section 102601
Section 102813
Section 104413

VISUAL DISPLAY BOARDS
PLASTIC TOILET PARTITIONS
WALL AND CORNER GUARDS
TOILET ACCESSORIES
FIRE EXTINGUISHERS AND CABINETS

DIVISION 11

Not a part of this manual.

DIVISION 12

Section 123661

QUARTZ SURFACING COUNTERTOPS

DIVISION 13-20

Not a part of this manual.

DIVISION 21

Section 210001

FIRE SUPPRESSION

FIRE SPRINKLER DESIGN-BUILD PERFORMANCE

DIVISION 22

Section 220500
Section 220503
Section 220519
Section 220523
Section 220529
Section 220553
Section 220700
Section 221100
Section 221300
Section 224000

PLUMBING

COMMON WORK RESULTS FOR PLUMBING
PIPES AND TUBES FOR PLUMBING PIPING AND EQUIPMENT
METERS AND GAUGES FOR PLUMBING PIPING
GENERAL-DUTY VALVES FOR PLUMBING PIPING
HANGER AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
PLUMBING INSULATION
FACILITY WATER DISTRIBUTION
FACILITY SANITARY SEWERAGE
PLUMBING FIXTURES

DIVISION 23	HEATING VENTILATING AND AIR CONDITIONING
Section 230500	COMMON WORK RESULTS FOR HVAC
Section 220503	PIPES AND TUBES FOR HVAC PIPING AND EQUIPMENT
Section 230523	GENERAL DUTY VALVES FOR HVAC PIPING
Section 230529	HANGERS AND SUPPORTS FOR HVAC
Section 230548	VIBRATION AND SEISMIC CONTROLS FOR HVAC
Section 230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
Section 230593	TESTING ADJUSTING AND BALANCING FOR HVAC
Section 230700	HVAC INSULATION
Section 230800	COMMISSIONING OF HVAC
Section 230923	INSTRUMENTATION AND CONTROLS FOR HVAC
Section 230993	SEQUENCE OF OPERATIONS FOR HVAC CONTROLS
Section 232116	HYDRONIC PIPING SPECIALTIES
Section 233100	HVAC DUCTS AND CASINGS
Section 233300	AIR DUCT ACCESSORIES
Section 233600	AIR TERMINAL UNITS
Section 233700	AIR OUTLETS AND INLETS
DIVISION 25	INTEGRATED AUTOMATION – Not a part of this manual.
DIVISION 26	ELECTRICAL
Section 260510	ELECTRICAL
Section 260511	SEISMIC AND WIND REQUIREMENTS FOR ELECTRICAL SYSTEMS
Section 260519	LOW-VOLTAGE CONDUCTORS AND CABLES
Section 260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
Section 260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
Section 260533	RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
Section 260553	ELECTRICAL IDENTIFICATION
Section 262416	PANELBOARDS
Section 262726	WIRING DEVICES
Section 262816	CIRCUIT BREAKERS
Section 262817	DISCONNECT SWITCHES
Section 265100	INTERIOR LIGHTING
DIVISION 27	COMMUNICATIONS
Section 270500	COMMUNICATIONS
Section 271310	COMMUNICATIONS CABLING
Section 272100	LABELING STANDARD
Section 272200	TESTING AND IDENTIFICATION
DIVISION 28	ELECTRONIC SAFETY AND SECURITY
Section 280001	FIRE ALARM SYSTEM PERFORMANCE
Section 281300	ELECTRONIC ACCESS CONTROL
DIVISIONS 29-31	Not a part of this manual.

DIVISION 32
Section 321313

EXTERIOR IMPROVEMENTS
PORTLAND CEMENT CONCRETE

DIVISION 33-47

Not part of this manual

DIVISION 48
Section 480001

ELECTRONIC SAFETY AND SECURITY
PHOTOVOLTAIC SYSTEM DESIGN/BUILD PERFORMANCE

END TABLE OF CONTENTS

**SOUTHERN OREGON UNIVERSITY
STANDARD PUBLIC IMPROVEMENT CONTRACT**

**INVITATION TO BID
Central Hall Phase 4
2nd Floor Tenant Improvements
ITB #2026-06**

Bids will be received by the **Southern Oregon University (SOU) Service Center, Computer Services Center-West Wing-2nd Floor, 1250 Siskiyou Boulevard, Ashland, Oregon** until **3:00 PM** local time **April 9, 2026** for the **Central Hall Phase 4 – 2nd Floor Tenant Improvements** project. Central Hall is located at 1175 Siskiyou Boulevard on the SOU campus in Ashland, Oregon.

This project includes all labor, materials and equipment required to build out the top floor of Central Hall. The work area is **approximately** 12,900 square feet. Bidders are required to field verify all quantities prior to submitting a bid. Work scope includes:

- wood frame partitions
- casework and architectural wood trim
- acoustical and thermal insulation
- wood doors, hollow metal doors & frames, door hardware
- glazing, translucent resin panels
- complete interior finishes (walls, floors, ceilings)
- architectural specialties
- fire suppression (extension of existing sprinkler system)
- plumbing (fixtures & piping)
- HVAC (branch ducting, terminal units, hydronics, mini-split, HVAC controls)
- electrical (subpanels, branch wiring, lighting, lighting controls)
- low voltage (data cabling, access controls, fire alarm system extension)
- one bid alternate to add a rooftop solar PV system

Bid Bonds are not required for this project. **Performance and Payment bonds are required.**

A **mandatory** pre-bid conference will be held on **Friday March 27, 2026, 10:00 am** at Central Hall, 1175 Siskiyou Boulevard, Ashland, OR. Meet at the west building entry. A representative for each prime bidder is required to attend.

SOU will procure and pay directly for City of Ashland permits (structural, mechanical, plumbing and electrical). The selected Contractor will be required to procure and pay for all required trade permits not included in the City of Ashland general permit.

Bids will be received on a lump sum basis. Bids must be submitted on the enclosed bid form and will be opened and publicly read aloud on **April 9, 2026 at 3:00 PM**, local time, at the **SOU Service Center, Computer Services Center -West Wing, 2nd Floor, 1250 Siskiyou Boulevard, Ashland, Oregon** by the undersigned or a designated representative.

The prime bidder and all subcontractors must be currently licensed to practice in each of their respective areas of expertise by the State of Oregon Construction Contractor's Board (CCB). The prime bidder shall have the required Public Works Bond on file with the CCB prior to submitting a bid. Failure to be registered and have the bond in place will result in the rejection of your bid as non-responsive. All subcontractors must file a Public Works Bond with the CCB prior to starting work on the project, unless exempt.

Oregon Bureau of Labor and Industries (BOLI) wage rates (ORS 279C.800 through ORS 279C.870) apply to this project. See SOU General Conditions, Sections C.1 and C.2, regarding wage rate compliance and payroll certification requirements. Workers shall be paid the applicable prevailing wage rates in accordance with ORS 279.838 and 279C.840. **Oregon BOLI Prevailing Wage Rates per the January 5, 2026 and including the February 18, 2026 amendment schedule apply to this project.**

Prevailing wage rates are available at <http://www.oregon.gov/BOLI>. If a contractor fails to pay for labor or services, SOU can pay and withhold these amounts from payments due the Contractor (ORS 279C.5.15). The Contractor and their subcontractors shall provide a written schedule to employees showing the number of hours per day and days per week the employee may be required to work (ORS 279C.520). The Contractor and their subcontractors must promptly pay for any medical services they have agreed to pay (ORS 279C.530).

Bid documents may be obtained from the SOU Procurement portal:
<https://sou.bonfirehub.com/portal/?tab=openOpportunities>
or the Oregon Public Universities website: <https://secure.orpu.org/bid> .

SOUTHERN OREGON UNIVERSITY

By: Jim McNamara
Capital Projects Manager
SOU Facilities Management and Planning

SOUTHERN OREGON UNIVERSITY
STANDARD PUBLIC IMPROVEMENT CONTRACT
INSTRUCTIONS TO BIDDERS

Table of Contents

<u>Article</u>	<u>Title</u>
1.	Scope of Work
2.	Examination of Site and Conditions
3.	Interpretation of Project Manual and Approval of Materials Equal to Those Provided in the Specifications
4.	Security to Be Furnished by Each Bidder
5.	Execution of Bid Bond
6.	Execution of the Bid Form
7.	Prohibition of Alterations to Bid
8.	Submission of Bid
9.	Bid Closing and Opening of Bids
10.	Acceptance or Rejection of Bids by Owner
11.	Withdrawal of Bid
12.	Execution of Contract, Agreement, Performance Bond and Payment Bond

INSTRUCTIONS TO BIDDERS

Oregon Administrative Rules Chapter 580, Divisions 61 and 63 govern this SOU procurement process.

Article 1. Scope of Work

The work contemplated under this contract with Southern Oregon University, hereinafter referred to as the Owner,

includes all labor, materials, transportation, equipment and services necessary for, and reasonably incidental to, the completion of all construction work in connection with the project described in the Project Manual which includes, but is not necessarily limited to, the Advertisement for Bids, Instructions to Bidders, Supplemental Instructions to Bidders, Bid Form, Bid Bond, Public Improvement Agreement Form, Performance Bond, Payment Bond,

SOU General Conditions, Supplemental General Conditions, Plans and Specifications.

Article 2. Examination of Site and Conditions

Before making a bid, the bidder shall examine the site of the work and ascertain all the physical conditions in relation thereto. The bidder shall also make a careful examination of the Project Manual including the plans, specifications, and other contract documents, and shall be fully informed as to the quality and quantity of materials and the sources of supply of the materials. Failure to take these precautions will not release the successful bidder from entering into the contract nor excuse the bidder from performing the work in strict accordance with the terms of the contract.

The Owner will not be responsible for any loss or for any unanticipated costs which may be suffered by the successful bidder as a result of such bidder's failure to be fully informed in advance with regard to all conditions pertaining to the work and the character of the work required. No statement made by an officer, agent, or employee of the Owner in relation to the physical conditions pertaining to the site of the work will be binding on the Owner, unless covered by the Project Manual or an Addendum.

Article 3. Interpretation of Project Manual and Approval of Materials Equal to Those Provided in the Specifications

If any bidder contemplating submitting a bid for the proposed contract is in doubt as to the true meaning of any part of the plans, specifications or forms of contract documents, or detects discrepancies or omissions, such bidder may submit to the Architect (read "Engineer" throughout as appropriate) a written request for an interpretation thereof at least 10 calendar days prior to the date set for the bid closing.

When a prospective bidder seeks approval of a particular manufacturer's material, process or item of equal value, utility or merit other than that designated by the Architect in the Project Manual, the bidder may submit to the Architect a written request for approval of such substitute at least 10 calendar days prior to the date set for the bid closing. The prospective bidder submitting the request will be responsible for its prompt delivery.

Requests of approval for a substitution from that specified shall be accompanied by samples, records of performance, certified copies of tests by impartial and recognized laboratories, and such other information as the Architect may request.

To establish a basis of quality, certain processes, types of machinery and equipment or kinds of materials may be specified in the Project Manual either by description of process or by designating a manufacturer by name and referring to a brand or product designation or by specifying a kind of material. Whenever a process is designated or a manufacturer's name, brand or item designation is given, or whenever a process or material covered by patent is designated or described, it shall be understood that the words "or approved equal" follow such name, designation or description, whether in fact they do so or not.

Any interpretation of the Project Manual or approval of manufacturer's material will be made only by an Addendum duly issued. A copy of each Addendum will be posted on the Oregon Public Universities procurement website. The Owner will not be responsible for any other explanation or interpretation of the Project Manual nor for any other approval of a particular manufacturer's process or item.

When the Architect approves a substitution by Addendum, it is with the understanding that the Contractor guarantees the substituted article or material to be equal or better than the one specified.

Article 4. Security to Be Furnished by Each Bidder

Each bid must be accompanied by either 1) a cashier's check or a certified check drawn on a bank authorized to do business in the State of Oregon, or 2) a bid bond described hereinafter, executed in favor of Southern Oregon University, for an amount equal to 10 percent of the total amount bid as a guarantee that if awarded the contract the bidder will execute the contract and give a performance bond and payment bond as required. The successful bidder's check or bid bond will be retained until the bidder has entered into a satisfactory contract and furnished a 100 percent performance bond and 100 percent payment bond. The Owner reserves the right to hold the bid security as described in Article 10 hereof. Should the successful bidder fail to execute and deliver the contract as provided for in Article 12, including a satisfactory performance bond and payment bond within 10 calendar

days after the bid has been accepted by the Owner, then the contract award made to such bidder may be considered canceled and the bid security may be forfeited as liquidated damages at the option of the Owner. The date of the acceptance of the bid and the award of the contract as contemplated by the Project Manual shall mean the date of acceptance specified in the Notice of Award.

Article 5. Execution of Bid Bond

Should the bidder elect to utilize a bid bond as described in Article 4 in order to satisfy the bid security requirements, such form must be completed in the following manner:

- A. Bid bonds must be executed on the Southern Oregon University form, which will be provided to all prospective bidders by the Owner.
- B. The bid bond shall be executed on behalf of a bonding company licensed to do business in the State of Oregon.
- C. In the case of a sole individual, the bond need only be executed as principal by the sole individual. In the case of a partnership, the bond must be executed by at least one of the partners. In the case of a corporation, the bond must be executed by stating the official name of the corporation under which is placed the signature of an officer authorized to sign on behalf of the corporation followed by such person's official capacity, such as president, etc. This signature shall be attested by the secretary or assistant secretary of the corporation. The corporation seal should then be affixed to the bond.
- D. The name of the surety must be stated in the execution over the signature of its duly authorized attorney-in-fact and accompanied by the seal of the surety corporation.

Article 6. Execution of the Bid Form

Each bid shall be made in accordance with the sample Bid Form accompanying these instructions; the appropriate signatures for a sole individual, partnership, corporation or limited liability corporation shall be added as noted in Article 5C above; numbers pertaining to base bids shall be stated both in writing and in figures; the bidder's address shall be typed or printed.

The Bid Form relates to bids on a specific Project Manual. Only the amounts and information asked for on the Bid Form furnished will be considered as the bid. Each bidder shall bid upon the work exactly as specified and provided in the Bid Form. The bidder shall include in the bid a sum to cover the cost of all items contemplated by the Contract. The bidder shall bid upon all alternates that may be indicated on the Bid Form. When bidding on an alternate for which there is no charge, the bidder shall write the words "No Charge" in the space provided on the Bid Form. If one or more alternates is shown on the Bid Form, the bidder shall indicate whether each is "add" or "deduct."

The Bid Form included in the Project Manual is a sample. One additional copy of the Bid Form may be furnished with the Project Manual. One additional copy of the Bid Bond form may also be provided with the Project Manual. Only one copy needs to be submitted with the bid.

Article 7. Prohibition of Alterations to Bid

Bids that are incomplete, or contain ambiguities or conditions not provided for in the Bid Form, may be rejected.

Article 8. Submission of Bid

Each bid shall be sealed in an envelope, properly addressed to Southern Oregon University, showing on the outside of the envelope the name of the bidder and the name of the project. Bids will be received at the time and place stated in the Advertisement for Bids.

Article 9. Bid Closing and Opening of Bids

All bids must be received by the Owner at the place and time set for the bid closing. Any bids received after the scheduled closing time for receipt of bids will be rejected and returned to the bidder unopened.

At the time of opening and reading of bids, each bid received will be publicly opened and read aloud, irrespective of any irregularities or informalities in such bids.

Article 10. Acceptance or Rejection of Bids by Owner

Unless all bids are rejected, the Owner will award a contract based on the lowest responsive bid from a responsible bidder. If that bidder does not execute the contract, it will be awarded to the next lowest responsible bidder or bidders in succession.

The Owner reserves the right to reject all bids and to waive minor informalities. The procedures for contract awards shall be in compliance with the provisions of Oregon Administrative Rules adopted by the Owner.

The Owner reserves the right to hold the bid and bid security of the three lowest bidders for a period of 30 calendar days from and after the time of bid opening pending award of the contract. Following award of the contract the bid security of the three lowest bidders may be held 20 calendar days pending execution of the contract. All other bids will be rejected and bid security will be returned.

In determining the lowest bidder, the Owner reserves the right to take into consideration any or all authorized base bids as well as alternates or combinations indicated in the Bid Form.

If such bid has not been accepted within 30 calendar days after the opening of the bids, each of the three lowest bidders may withdraw the bid submitted and request the return of the bid security.

Article 11. Withdrawal of Bid

At any time prior to the time and place set for the bid closing, a bidder may withdraw the bid. This will not preclude the submission of another bid by such bidder prior to the time set for the bid closing.

After the time set for the bid closing, no bidder will be permitted to withdraw its bid within the time frames specified in Article 10 for award and execution, except as provided for in that Article.

Article 12. Execution of Contract, Agreement, Performance Bond and Payment Bond

The Owner will provide the successful bidder with contract forms within 10 calendar days after the award of the Contract. The bidder is required to execute the contract forms as provided, including a performance bond and a

payment bond from a surety company licensed to do surety business in the State of Oregon, within 10 calendar days after the award of the contract. The contract forms shall be delivered to the Owner in the number called for and to the location as noted in the Notice of Award.

Article 13. Recyclable Products

Contractors will use recyclable products to the maximum extent economically feasible in the performance of the Contract.

SOUTHERN OREGON UNIVERSITY
STANDARD PUBLIC IMPROVEMENT CONTRACT

SUPPLEMENTAL INSTRUCTIONS TO BIDDERS

Project Name: Central Hall Phase 4 - 2nd Floor TI

The following modify the SOUTHERN OREGON UNIVERSITY “Instructions to Bidders, Form B-2” for this procurement. Where a portion of the Instructions to Bidders has been modified by these Supplemental Instructions to Bidders, the unaltered portions shall remain in effect.

Bid Bonds are not required for this project.
Performance Bonds and Payment Bonds are required for this project

A Builder’s Risk Insurance Policy is required for this project.

[Submission of Bids through SOU procurement (Bonfire) portal]

Complete Bids (including all attachments) may be submitted electronically and must be received by the Closing Date and Time **April 9, 2026 at 3:00 p.m. Local Time.** The Bid may be submitted through the Bonfire portal: <https://sou.bonfirehub.com/portal>.

Bidders may also submit a sealed bid to the SOU Service Center per the instructions in this ITB. Bids must be received by **April 9, 2026 at 3:00 p.m. Local Time.** The sealed bid must be clearly marked “*ITB2026-06 Central Hall Phase 4-2nd Floor TI*” on the outside of the sealed envelope.

SOUTHERN OREGON UNIVERSITY
STANDARD PUBLIC IMPROVEMENT CONTRACT
BID FORM – ITB 2026-06

OWNER: **Southern Oregon University**

PROJECT: **Central Hall Phase 4 – 2nd Floor Tenant Improvements**

BID CLOSING: **April 9, 2026, 3:00 PM Local Time**

BID OPENING: **April 9, 2026, 3:00 PM Local Time**

FROM: _____
 Name of Contractor

TO: **Southern Oregon University**
 Facilities Management and Planning
 351 Walker Avenue
 Ashland, Oregon 97520

1. The Undersigned (*check one of the following and insert information requested*):

_____ a. An individual doing business under an assumed name registered under the laws of
 the State of _____; or

_____ b. A partnership registered under the laws of the State of _____;
or

_____ c. A corporation organized under the laws of the State of _____; or

_____ d. A limited liability corporation organized under the laws
 of the State of _____;

hereby proposes to furnish all material and labor and perform all work hereinafter indicated
for the above project in strict accordance with the Contract Documents for the as follows:

2. Bid for all work as described in the plans and specifications:
Central Hall Phase 4 – 2nd Floor Tenant Improvements (ITB 2026-06)

BASE BID: Perform all work per Specifications (Attachment A) and Drawings (Attachment B)

LUMP SUM: (\$ _____)

Lump Sum in Words: _____

ALTERNATES

The Undersigned proposes to add to the Base Bid indicated above the items of work relating to the following Alternate(s) as designated in the Specifications:

ALTERNATE #1 – Add Grid-Tied Rooftop Solar Photovoltaic System

ADD: \$ _____

Alt #1 in words: _____

and the Undersigned agrees to be bound by the following documents:

- Invitation for Bids (ITB 2026-06)
- Attachment A – Project Manual
- Attachment B - Drawings
- Oregon BOLI Wage Rates

ADDENDA numbered ____ through ____, inclusive (*fill in blanks*)

3. All work shall be completed by the dates shown in ITB 2026-06.
4. The Undersigned certifies that: (1) This Bid has been arrived at independently and is being submitted without collusion with and without any agreement, understanding, or planned common course of action with any other vendor of materials, supplies, equipment or services described in the invitation to bid designed to limit independent bidding or competition; and (2) The contents of the Bid have not been communicated by the Undersigned or its employees or agents to any person not an employee or agent or its surety on any bond furnished with this bid and will not be communicated to such person prior to the official opening of the Bid.
5. The undersigned **HAS, HAS NOT** (*circle applicable status*) paid unemployment or income taxes in Oregon within the past 12 months and **HAS, HAS NOT** (*circle applicable status*) a business address in Oregon.
6. The Undersigned agrees, if awarded a contract, to comply with the provisions of ORS 279C.800 through 279C.870 pertaining to the payment of the prevailing rates of wage if the bid exceeds \$50,000.00.
7. Contractor's CCB registration number is _____. As a condition

to submitting a bid, a Contractor must be registered with the Oregon Construction Contractors Board in accordance with ORS 701.035 to 701.055, and disclose the registration number. Failure to register and disclose the number will make the bid unresponsive and it will be rejected, unless contrary to federal law.

8. The successful Bidder hereby certifies that all subcontractors who will perform construction work as described in ORS 701.005(2) were registered with the Construction Contractors Board in accordance with ORS 701.035 to 701.055 at the time the subcontractor(s) made a bid to work under the contract.

9. The successful Bidder hereby certifies that, in compliance with the Worker's Compensation Law of the State of Oregon, its Worker's Compensation Insurance provider is _____, Policy No. _____, and that Contractor shall submit Certificates of Insurance as required.

10. Contractor's Project Manager for this project is: _____,
Office Phone: _____ Cell Phone: _____.

11. Bidder Certification: By signature on this Bid Form the undersigned certifies that they are authorized to act on behalf of the Entity and that under penalty of perjury the undersigned will comply with the following:

SECTION I. OREGON TAX LAWS

As required in ORS 305.385(6) the undersigned hereby certifies that to the best of the undersigned's knowledge, the Entity is not in violation of any Oregon Tax Laws. For purposes of this certification, "Oregon Tax Laws" means a state tax imposed by ORS 403.200 to 403.250 (Tax For Emergency Communications), 118 (Inheritance Tax), 314 (Income Tax), 316 (Personal Income Tax), 317 (Corporation Excise Tax), 318 (Corporation Income Tax), 320 (Amusement Device and Transient Lodging Taxes), 321 (Timber And Forestland Tax), 323 (Cigarettes And Tobacco Products Tax), and any local taxes administered by the Department of Revenue under ORS 305.620. If a Contract is executed, this information will be reported to the Internal Revenue Service under the name and taxpayer I.D. number submitted below. Information not matching IRS records could subject Contractor to 31 percent backup withholding.

SECTION II. AFFIRMATIVE ACTION

The undersigned hereby certifies that they have not discriminated against Minority, Women or Emerging Small Business Enterprises in obtaining any required subcontracts, pursuant to SOU's Procurement and Contracting Code (FAD.057 (580-061)).

SECTION III. COMPLIANCE WITH SOLICITATION

The undersigned agrees and certifies that they:

1. Have read, understand, and agree to be bound by and comply with all requirements, instructions, specifications, terms and conditions contained herein (including any attachments); and
2. Are an authorized representative of the Entity, that the information provided is true and accurate, and that providing incorrect or incomplete information may be cause for rejection of the offer or contract termination; and
3. Will furnish the designated item(s) and/or service(s) in accordance with the solicitation and the

- contract; and
4. Will provide/furnish federal employee identification number or social security number with offer.

Minority, Women & Emerging Small Business (MWESB) Certified Firm: ☐Yes ☐No

If yes, Minority, Women & Emerging Small Business (MWESB) Certification Number: _____

By signature below, Contractor agrees to be bound by this Bid.

NAME OF FIRM _____

ADDRESS _____

FEDERAL TAX ID _____

TELEPHONE NO _____

EMAIL _____

SIGNATURE 1) _____
Sole Individual

or 2) _____
Partner

or 3) _____
Authorized Officer of Corporation or LLC

PRINTED NAME _____
Print Name and Title of Contractor Signatory

Payment information will be reported to the IRS under the name and taxpayer ID # provided above. Information not matching IRS records could subject Contractor to 31 percent backup withholding.

******* END OF BID *******

**SOUTHERN OREGON UNIVERSITY
FIRST-TIER SUBCONTRACTOR DISCLOSURE FORM**

This form must be submitted at the location specified in the Invitation to Bid within two (2) working hours after the date and time of the deadline when the bids are due.

List below the name of each subcontractor that will be furnishing labor or labor and materials and that is required to be disclosed by ORS 279C.370, the dollar value of the subcontract and the category of work that the subcontractor will be performing.

*Enter "**NONE**" if there are no subcontractors that need to be disclosed.
(ATTACH ADDITIONAL SHEETS IF NEEDED)*

Project Name: SOU Central Hall Phase 4 – 2nd Floor TI (ITB 2026-06)

Bid Closing Date: April 9, 2026. Time: 3:00 PM

SUBCONTRACTOR NAME (Please Print)	DOLLAR VALUE	CATEGORY/DIVISION OF WORK (Painting, electrical, landscaping, etc.)
Name	\$	
Name	\$	
Name	\$	
Name	\$	
Name	\$	
Name	\$	
Name	\$	
Name	\$	
Name	\$	
Name	\$	
Name	\$	
Failure to submit this form within 2 hours of the bid closing will result in a non-responsive bid. A non-responsive bid will not be considered for award.		

Form submitted by (Bidders Name): _____

Contact Name: _____ Phone No.: _____

SOUTHERN OREGON UNIVERSITY PUBLIC IMPROVEMENT AGREEMENT FORM

This Agreement for the **(Insert Project Name)** (the "Contract"), made by **SOUTHERN OREGON UNIVERSITY**, hereinafter called OWNER, and **(Insert Contractor's Name)** hereinafter called the CONTRACTOR (collectively the "Parties"), shall become effective on **(Insert contract award date)**, or the date this Contract has been signed by all the Parties.

WITNESSETH:

1. Contract Price, Contract Documents and Work.

The CONTRACTOR, in consideration of the sum of _____ (the "Contract Price"), to be paid to the CONTRACTOR by OWNER in the manner and at the time hereinafter provided, and subject to the terms and conditions provided for in the Instructions to Bidders and other Contract Documents (as defined in the SOU General Conditions referenced within the Instructions to Bidders), all of which are incorporated herein by reference, hereby agrees to perform all Work described and reasonably inferred from the Contract Documents. The Contract Price is the amount contemplated by the Base Bid adjusted for Alternates **[Identify accepted Alternates]**, as indicated in the accepted Bid.

Also, the following documents are incorporated by reference in this Contract and made a part hereof if checked for inclusion [X]:

[] (RESERVED)

2. Representatives.

CONTRACTOR has named **(Insert Name)** its' Authorized Representative to act on its behalf. OWNER designates, or shall designate, its Authorized Representative as indicted below (check one):

[] Unless otherwise specified in the Contract Documents, the OWNER designates **(Insert Name)** as its Authorized Representative in the administration of this Contract. The above-named individual shall be the initial point of contact for matters related to Contract performance, payment, authorization, and to carry out the responsibilities of the OWNER.

[] Name of OWNER'S Authorized Representative shall be submitted by OWNER in a separate writing.

3. Key Persons.

The CONTRACTOR'S personnel identified below shall be considered Key Persons and shall not be replaced during the project without the written permission of Owner, which shall not be unreasonably withheld. If the CONTRACTOR intends to substitute personnel, a request must be given to Owner at least 30 days prior to the intended time of substitution. When replacements have been approved

by Owner, the CONTRACTOR shall provide a transition period of at least 10 working days during which the original and replacement personnel shall be working on the project concurrently. Once a replacement for any of these staff members is authorized, further replacement shall not occur without the written permission of Owner. The CONTRACTOR'S project staff shall consist of the following personnel:

Project Manager: _____ shall be the CONTRACTOR'S project manager and will participate in all meetings throughout the project term.

Job Superintendent: _____ shall be the CONTRACTOR'S on-site job superintendent throughout the project term.

4. Contract Dates.

COMMENCEMENT DATE: Within **(Insert # of Days)** Days of the Notice to Proceed.

SUBSTANTIAL COMPLETION DATE: **(Insert # of Days)** from "Notice to Proceed" **(or a date certain)**.

FINAL COMPLETION DATE: **(Insert # of Days)** from "Notice to Proceed" **(or a date certain)**.

5. Tax Compliance.

The individual signing on behalf of CONTRACTOR hereby certifies and swears under penalty of perjury that s/he is authorized to act on behalf of CONTRACTOR s/he has authority and knowledge regarding CONTRACTOR'S payment of taxes, and to the best of her/his knowledge, CONTRACTOR is not in violation of any Oregon tax laws. For purposes of this certification, "tax" means those programs listed in ORS 305.380(4). For purposes of this certification, "tax laws" means a state tax imposed by ORS 401.792 to 401.816 and ORS chapters 118, 314, 316, 317, 318, 320, 321 and 323; the elderly rental assistance program under ORS 310.630 to 310.706; and local taxes administered by the Department of Revenue under ORS 305.620.

6. Integration

The Contract documents constitute the entire agreement between the parties. There are no other understandings, agreements or representations, oral or written, not specified herein regarding this Contract. CONTRACTOR, by the signature below of its authorized representative, hereby acknowledges that it has read this Contract, understands it, and agrees to be bound by its terms and conditions.

In witness whereof, Southern Oregon University executes this Contract and the CONTRACTOR does execute the same as of the day and year first above written.

CONTRACTOR DATA:

(Insert Contractor Name & Address)

CONTRACTOR NAME _____

CONTRACTOR FEDERAL TAX ID # _____
CONTRACTOR CCB # _____ Expiration Date: _____

[Payment information will be reported to the IRS under the name and taxpayer ID # provided above. Information must be provided prior to contract approval. Information not matching IRS records could subject Contractor to 31 percent backup withholding.]

CONTRACTOR SIGNATURE

By _____
Signature Date

Print Name	Title

SOUTHERN OREGON UNIVERSITY

By _____
Name/Title Date

By _____
Name/Title Date

**SOUTHERN OREGON UNIVERSITY
STANDARD CONTRACT PROVISIONS**

1. **ACCESS TO RECORDS.** Contractor will maintain records, sufficient to accurately document its performance of this Contract. University will have access to such records of Contractor for the purpose of determining compliance with this Contract. Contractor will retain all such records, for a minimum of six years following final payment under or termination of this Contract, or such longer period as may be required by applicable law or to conclude any audit, review, or controversy.

2. **INDEMNITY FOR INFRINGEMENT CLAIMS.** EXCEPT TO THE EXTENT ARISING FROM MATERIALS PROVIDED TO CONTRACTOR BY UNIVERSITY, WHICH MATERIALS ARE UTILIZED BY CONTRACTOR IN THEIR UNALTERED FORM AND WITHOUT LIMITING THE GENERALITY OF THE INDEMNIFICATION CLAUSE REFERENCED IN THE HOLD HARMLESS SECTION BELOW, CONTRACTOR EXPRESSLY AGREES TO INDEMNIFY AND HOLD HARMLESS UNIVERSITY AND ITS GOVERNING BOARD, DIRECTORS, OFFICERS, EMPLOYEES, AND AGENTS FROM AND AGAINST ANY AND ALL CLAIMS, SUITS, ACTIONS, LOSSES, LIABILITIES, COSTS, EXPENSES, AND DAMAGES ARISING OUT OF OR RELATED TO ANY CLAIMS THAT THE DELIVERABLES INFRINGE ANY PATENT, COPYRIGHT, TRADE SECRET, TRADEMARK, TRADE DRESS, MASK WORK, UTILITY DESIGN, OR OTHER PROPRIETARY RIGHT OF ANY THIRD PARTY. The indemnity under this Section will not apply to the extent such alleged or actual infringement arises as a result of (i) modifications of such work made by University which were not approved by Contractor, or (ii) Contractor's compliance with any of University's designs, specifications or instructions. In the event that a court of competent jurisdiction determines in a final, non-appealable order that the work is infringing in a manner for which Contractor is obligated to indemnify University pursuant to this Section, Contractor will, at its option, (1) procure for University the right to continue using such infringing work; (2) replace the infringing work with a non-infringing item of like form, fit or function; or (3) modify the work so that it no longer infringes.

3. **HOLD HARMLESS.** Contractor will be responsible for all damage to property, injury to persons, and loss, expense, inconvenience, and delay which may be caused by, or result from any act or omission of Contractor, its subcontractors, agents, or employees. Contractor will indemnify and hold harmless University, its governing board and their directors, officers, agents, employees, and members from all claims, suits, and actions of any nature resulting from or arising out of the acts or omissions of Contractor or its subcontractors, officers, agents, or employees.

4. **INSURANCE.** Contractor shall secure at its own expense and keep in effect during the term of the Contract either comprehensive general liability insurance with broad form CGL endorsement or commercial general liability insurance with a minimum limit of \$2,000,000 per occurrence and auto liability insurance with a minimum limit of \$2,000,000 per occurrence, each with annual aggregate limit of \$4,000,000. Insurance policies, which cannot be excess to a self-insurance program, are to be issued by an insurance company authorized to do business in the State of Oregon. Southern Oregon University, and its governing board, officers and employees shall be included as an additional insured in said insurance

policy. If any of the liability insurance is arranged on a "claims made basis," then "tail" coverage will be required at the completion of the Contract for duration of twenty-four (24) months. University may require that the Contractor furnish the University with certificate(s) of insurance as evidence of insurance coverage before commencing work under the Contract.

5. **INDEPENDENT CONTRACTOR STATUS.** The services to be rendered under this Contract are those of an independent contractor. Contractor is not to be considered an agent or employee of University for any purpose, and neither Contractor nor any of Contractor's agents or employees are entitled to any of the benefits that University provides for its employees. Nothing in this Contract will be construed to create a partnership, joint venture, franchise, agency, or employment relationship between the Parties. Notwithstanding the generality of the foregoing and for the avoidance of doubt, Contractor will not be working under the direction and control of University, and this Contract is non-exclusive for both parties.

6. **OWNERSHIP OF WORK PRODUCT.** All work product of Contractor that results from this Contract ("Work Product") is the exclusive property of University. University and Contractor intend that such Work Product be deemed "work made for hire" of which University will be deemed the author. If for any reason the Work Product is not deemed "work made for hire," Contractor by this Contract irrevocably assigns to University all its right, title, and interest in and to any and all of the Work Product, whether arising from copyright, patent, trademark, trade secret, or any other state or federal intellectual property law or doctrine. Contractor will execute such further documents and instruments as University may reasonably request in order to fully vest such rights in University. Contractor forever waives any and all rights relating to the Work Product, including without limitation, any and all rights arising under 17 USC 106A or any other rights of identification of authorship or rights of approval, restriction or limitation on use or subsequent modifications.

7. **REPRESENTATIONS AND WARRANTIES.** Contractor represents and warrants that (1) Contractor has the power and authority to enter into and perform this Contract; (2) The individual signing for Contractor is authorized to execute this Contract on behalf of Contractor; (3) This Contract, when executed and delivered, will be a valid and binding obligation of Contractor, enforceable in accordance with its terms; (4) The work under this Contract will be performed in a good and workmanlike manner and in accordance with the highest professional standards; (5) Contractor will, at all times during the term of this Contract, be qualified, professionally competent, and duly licensed to perform the work; and (6) Contractor's name, as it appears in this Contract, is Contractor's legal name, as it will appear in the Contractor's W-9, and if Contractor is an entity rather than an individual that the entity named in this Contract is validly existing and in good standing. The warranties set forth in this Section are in addition to, and not in lieu of, any other warranties provided.

8. **EQUAL EMPLOYMENT OPPORTUNITY NOTICES.** This contractor and subcontractor shall abide by the requirements of 41 CFR §§60-1.4(a), 60-300.5(a) and 60-741.5(a), which are incorporated by reference. These regulations prohibit discrimination against qualified individuals based on their status as protected veterans or individuals with disabilities, and prohibit discrimination against all individuals based on their race, color, religion, sex, or national origin. Moreover, these regulations require that covered prime contractors and subcontractors take affirmative action to employ and advance in employment qualified

individuals without regard to race, color, religion, sex, national origin, protected veteran status or disability.

9. TERMINATION. (a) This Contract may be terminated at any time by mutual written consent of both Parties.

(b) University may at its sole discretion terminate this Contract in whole or in part upon 30-days' written notice to Contractor.

(c) University may terminate this Contract effective upon delivery of written notice to Contractor, or at such later date as may be established by University if: (i) federal or state laws, rules, regulations, or guidelines are modified or interpreted in such a way that any Deliverables or services to be provided by Contractor under this Contract are no longer allowable or appropriate for purchase by University or are no longer eligible for the funding proposed for payment authorized by this Contract; (ii) any license or certificate required by law or regulation to be held by Contractor to provide Deliverables under this Contract is denied, revoked, or not renewed for any reason; (iii) if Contractor becomes insolvent or admits in writing its inability to pay its debts as they mature, or makes an assignment for the benefit of creditors; (iv) if a petition under any foreign, state, or United States bankruptcy act, receivership statute, or the like, as they now exist, or as they may be amended, is filed by Contractor; or (v) if such a petition is filed by any third party, or an application for a receiver is made by anyone and such petition or application is not resolved favorably to Contractor within ninety (90) calendar days. (d) University may terminate by written notice of default (including breach of contract) to Contractor the whole or any part of this Agreement if: (i) Contractor fails to provide services called for by this Agreement within the time specified in this Agreement or any extension of this Agreement; or (ii) Contractor fails to perform any of the other provisions of this Agreement, or fails to pursue the Work so as to endanger performance of this Agreement in accordance with its term and, after receipt of written notice from University, fails to correct such failures within 10 days or such longer period as University may determine at University's sole discretion. In addition to the right to terminate, in the event of a default by Contractor under this section, University will have all other rights and remedies at law or in equity.

10. TERMINATION DUE TO NON- APPROPRIATION OF FUNDS. University may terminate this Contract upon written notice to Contractor if it has not: (a) Received from the Oregon Legislative Assembly appropriations, limitations or expenditure authority, or (b) Received allotments from the Higher Education Coordinating Commission or allotments pursuant to ORS Chapter 291, sufficient to allow University, in the exercise of its reasonable administrative discretion, to pay the amounts of this Contract.

11. REMEDIES. (a) In the event of termination pursuant to Section 9(b), 9(c)(i), or 10, Contractor's sole remedy will be a claim for the sum designated for accomplishing the work multiplied by the percentage of work completed and accepted by University, less previous amounts paid and any claim(s) which University has against Contractor. If previous amounts paid to Contractor exceed the amount due to Contractor under this subsection, Contractor will pay any excess to University upon demand. (b) In the event of termination pursuant to Sections 9(c)(ii) or (d), University will have any remedy available to it in law or equity. If it is determined for any reason that Contractor was not in default under these subsections, the rights and obligations of the Parties will be the same as if the Contract was terminated pursuant to Section 9(b). (c) Upon receiving a notice of termination of this Contract, Contractor will immediately cease all activities under this Contract, unless University expressly directs otherwise in writing. Upon termination, Contractor will deliver to orientation, status as a veteran, or handicap.

University all Work Product, documents, information, works-in-progress and other materials that are or would be deliverables or otherwise the property of University had the Contract been completed. Upon University's request, Contractor will surrender to anyone University designates, all documents, research or objects or other tangible things needed to complete the work.

12. SUBCONTRACTS AND ASSIGNMENTS.

Notwithstanding anything in Sections 3, 8, or any other reference to subcontractors in this Contract, Contractor will not subcontract, assign, or transfer any of its interest in this Contract without obtaining prior written approval from University, which consent may be withheld by University in its discretion. As a condition to requesting prior written approval, Contractor must provide a written copy of any such proposed assignment or subcontract to University. University's consent to any assignment or subcontract will not relieve Contractor of any of its duties or obligations under this Contract. Any assignment or subcontract in contravention of this Section will be null and void.

13. CONFLICT OF INTEREST. Contractor covenants that it presently has no interest and will not acquire any interest, direct or indirect, which would conflict in any manner with or prohibit Contractor's full performance of this Contract. Contractor also covenants that in the performance of this Contract no person having any such interest will be employed. Contractor further covenants that its performance of this Contract will not cause any employee or volunteer of University to violate ORS Chapter 244.

14. LIMITATION OF LIABILITIES. UNIVERSITY WILL NOT BE LIABLE FOR (i) ANY INDIRECT, INCIDENTAL, CONSEQUENTIAL, OR SPECIAL DAMAGES UNDER THIS CONTRACT, OR (ii) ANY DAMAGES OF ANY SORT ARISING SOLELY FROM THE TERMINATION OF THIS CONTRACT IN ACCORDANCE WITH ITS TERMS.

15. WARRANTIES. Unless otherwise stated, all equipment shall be new and current models and shall carry full factory warranties. Contractor warrants all goods delivered to be free from defects in labor, material, and manufacture and to be in compliance with bid specifications. All implied or express warranty provisions of the Uniform Commercial Code (ORS, Chapter 72) are incorporated in this Contract. All warranties shall run to the State.

16. NOTICES. Except as otherwise expressly provided in this Contract, any communications between the Parties or notices to be given under this Contract will be given in writing by personal delivery, facsimile, or mailing the same, postage prepaid, to Contractor or University at the address or number set forth on the first page of this Contract, or to such other addresses or numbers as the Parties may from time to time direct in writing. Any communication or notice so addressed and mailed will be deemed to be given five days after mailing. Any communication or notice delivered by facsimile will be deemed to be given when receipt of the transmission is generated by the transmitting machine. To be effective against University, such facsimile transmission must be confirmed by telephone notice to University's supervising representative. Any communication or notice by personal delivery will be deemed to be given when actually delivered.

17. CAPTIONS. The captions or headings in this Contract are for convenience only and in no way affect the meaning or interpretation of this Contract.

18. COMPLIANCE WITH APPLICABLE LAW. Contractor will comply with all applicable federal, state, and local laws, ordinances, regulations, and University policies. Contractor also agrees to comply with all applicable laws prohibiting discrimination on the basis of race, sex, national origin, religion, age, sexual

19. WORKERS' COMPENSATION. Contractor, its subcontractors, if any, and all employers providing work, labor, or materials under this Contract are subject employers under the Oregon Workers' Compensation Law, and shall either comply with ORS 656.017, which requires said employers to provide workers' compensation coverage that satisfies Oregon law for all their subject workers, or shall comply with the exemption set out in 656.126.

20. GOVERNING LAW; JURISDICTION; VENUE. This Contract will be governed and construed in accordance with the laws of the State of Oregon without regard to principles of conflicts of law. Any claim, action, or suit between University and Contractor will be brought and conducted solely and exclusively within a Circuit Court located in Jackson County, Oregon. However, if any claim, action, or suit must be brought in a federal forum, it will be brought and conducted exclusively in the United States District Court for the District of Oregon. In no event will any part of this Contract be construed as a waiver by University of its sovereign and governmental immunities. BY EXECUTION OF THIS CONTRACT, CONTRACTOR CONSENTS TO IN PERSONAM JURISDICTION OF SUCH COURTS.

21. ATTORNEY FEES. In the event a lawsuit of any kind is instituted on behalf of the University to collect any payment due or to obtain performance of any kind under this Contract, Contractor shall pay such additional sums as the court may adjudge as reasonable attorney fees plus all costs and disbursements at trial and on any appeal.

22. PAYMENT. Payment for completion of State of Oregon public university contracts is normally made within 30 days following the date the entire order is delivered and accepted or the date the invoice is received, whichever is later. After 45 days, Contractor may assess overdue account charges up to a maximum rate of two-thirds of one percent per month on the outstanding balance (ORS 293.462).

23. RECYCLED PRODUCTS. Unless expressly otherwise provided for in this Contract, all paper products will be sourced from mills using elemental chlorine-free processes and contain a minimum of 30% post-consumer waste.

24. HAZARD COMMUNICATION. Contractor will notify University prior to using products containing hazardous chemicals to which University employees may be exposed. Products containing hazardous chemicals are those products defined by Oregon Administrative Rules Chapter 437.

25. SAFETY AND HEALTH REQUIREMENTS. Equipment and services supplied shall comply with all federal Occupational Safety and Health Administration (OSHA) requirements and with all Oregon safety and health requirements including those of the State Workers' Compensation Department.

26. DELIVERY. All deliveries shall be F.O.B. destination with all transportation and handling charges paid by Contractor. Responsibility for loss or damage shall remain with Contractor until final inspection and acceptance when responsibility shall pass to the University except as to latent defects, fraud, and Contractor's warranty obligations.

27. INSPECTIONS. Goods furnished under this Contract shall be subject to inspection and test by the University at times and places determined by it. If it finds goods furnished to be incomplete or not in compliance with bid specifications, the University may reject the goods and require Contractor to either correct them without charge or deliver them at a reduced price. If Contractor is unable or refuses to correct such goods within a time deemed reasonable by the University, the University may cancel the order in whole or in part.

28. SURVIVAL. All provisions of this Contract that would reasonably be expected to survive its termination will do so.

29. SEVERABILITY. If any term or provision of this Contract is declared by a court of competent jurisdiction to be illegal or in conflict with law, the validity of the remaining terms and provisions will not be affected. The Parties agree to attempt to substitute for any illegal or unenforceable provision a valid one that achieves the economic, legal and commercial objectives of the unenforceable provision to the greatest extent possible.

30. SUCCESSORS IN INTEREST. This Contract will be binding upon and will inure to the benefit of the Parties, and their respective successors and assigns.

31. ECONOMIC OPPORTUNITIES. Contractor will, when applicable, have made good faith efforts to work with or obtain materials to be used in performing the Contract from minority-owned, women-owned, and emerging small business enterprises.

32. FOREIGN CORRUPT PRACTICES. Contractor shall comply with all applicable laws relating to anti-corruption or anti-bribery, including, but not limited to, the requirements of the Foreign Corrupt Practices Act of 1977, as amended, (FCPA) (15 U.S.C. §§78dd-1, et. seq.), regardless of whether contractor is within the jurisdiction of the United States. Contractor shall not, either directly or indirectly, pay, offer, give, or promise to pay or give, any portion of monies or anything of value received from the University to a public official or any person in violation of the FCPA and/or in violation of any applicable local laws relating to anti-corruption or anti-bribery.

33. FEDERAL PROVISIONS. If this Contract is federally funded in whole or in part, Contractor must comply with all applicable provisions of the Office of Management and Budget's Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards. Further, if Federal Funding Accountability and Transparency Act (FFATA) applies, Contractor is required to submit certain information to University. If Contractor fails to timely submit such required information, University reserves the right to cancel this Contract or, if work has been performed, withhold payment until such required submittals have been received.

34. EXCLUSIVITY. University is not bound by exclusivity provisions.

35. DUAL PAYMENT. Contractor will not be compensated by any other party for work under this Contract.

36. NO THIRD PARTY BENEFICIARIES. University and Contractor are the only parties to this Contract and are the only parties entitled to enforce its terms. Nothing in this Contract gives, is intended to give, or will be construed to give any benefit or right, whether directly or indirectly, to third persons unless such persons are individually identified by name and expressly described in this Contract as intended beneficiaries.

37. TIME IS OF THE ESSENCE. Contractor agrees that time is of the essence under this Contract.

38. FEDERAL TAX IDENTIFICATION NUMBER. All Contractors must furnish upon request a federal tax identification number to Southern Oregon University. Failure to provide this information could result in invoice payments being withheld.

39. FOREIGN CONTRACTOR. If Contractor is not domiciled or registered to do business in the State of Oregon, Contractor will provide to the Oregon Department of Revenue and the Secretary of State, Corporation Division, all information required by those agencies relative to this Contract. Contractor will demonstrate its legal capacity to perform these services in the State of Oregon prior to entering into this Contract.

40. FORCE MAJEURE. Neither University nor Contractor will be held responsible for delay or default caused by fire, riot, acts of God, terrorist acts, public emergencies, or other acts of political sabotage, or war where such cause was beyond, respectively, University or Contractor's reasonable control. Contractor will, however, make all reasonable efforts to remove or eliminate such cause of delay or default and will, upon the cessation of the cause, diligently pursue performance of the Contract.

41. WAIVER. The failure of University to enforce any provision of this Contract will not constitute a waiver by University of that or any other provision.

42. ATTACHMENTS. All attachments, addenda, schedules and exhibits which are referred to in this Contract are incorporated in this Contract.

43. MERGER. THIS CONTRACT CONSTITUTES THE ENTIRE AGREEMENT BETWEEN THE PARTIES. THERE ARE NO UNDERSTANDINGS, AGREEMENTS, OR REPRESENTATIONS, ORAL OR WRITTEN, NOT SPECIFIED IN THIS CONTRACT REGARDING THIS CONTRACT. NO AMENDMENT, CONSENT, OR WAIVER OF TERMS OF THIS CONTRACT WILL BIND EITHER PARTY UNLESS IN WRITING AND SIGNED BY ALL PARTIES. ANY SUCH AMENDMENT, CONSENT, OR WAIVER WILL BE EFFECTIVE ONLY IN THE SPECIFIC INSTANCE AND FOR THE SPECIFIC PURPOSE GIVEN. CONTRACTOR, BY THE SIGNATURE TO THIS CONTRACT OF ITS AUTHORIZED REPRESENTATIVE, ACKNOWLEDGES HAVING READ AND UNDERSTOOD THE CONTRACT AND CONTRACTOR AGREES TO BE BOUND BY ITS TERMS AND CONDITIONS.

44. ACCESSIBILITY REQUIREMENTS. Contractor will conform to all applicable Web standards and Web accessibility, specifically WCAG 2.0 (Level A).

45. CONFIDENTIAL INFORMATION. Contractor acknowledges that it and its employees or agents may, in the course of performing their responsibilities under this Contract, be exposed to or acquire information that is confidential to University or the State of Oregon. Any and all information of any form obtained by Contractor or its employees or agents in the performance of this Contract shall be deemed confidential information of University and of State ("Confidential Information"). Contractor agrees to hold Confidential Information in strict confidence, using at least the same degree of care that Contractor uses in maintaining the confidentiality of its own confidential information, and not to copy, reproduce, sell assigned, license, market, transfer or otherwise dispose of, give, or disclose Confidential Information to third parties or use Confidential Information for any purposes whatsoever other than in the performance of the Contract, and to advise each of its employees and agents of their obligations to keep Confidential Information confidential. Contractor agrees that Contractor will not at any time during or after the term of this Contract disclose, directly or indirectly, and Confidential Information to any person, and that upon

termination of this Contract, or at University's request, Contractor will turn over to University all documents, papers and other material in Contractors' possession which contain Confidential Information.

46. FAMILY EDUCATIONAL RIGHTS AND PRIVACY ACT. Contractor agrees to protect confidentiality of student information and to comply with the Family Educational Rights and Privacy Act of 1974 (FERPA) and its implementing regulations, specifically 20 U.S.C. 1232g, 34 C.F.R. § 99.1 et seq., UO Policy 571-020, with respect to any redisclosure of personally identifiable information from education records obtained from the University.

47. AMBIGUITIES. Each party has participated fully in the review and revision of this Contract and neither party shall be considered the "drafter" for the purposes of any rule of construction that might cause any provision to be construed against the drafter of the Contract.

48. OREGON PUBLIC RECORDS LAW

Contractor hereby acknowledges that any information it discloses to University, any duty of the University to maintain the confidentiality of such information, or any duty of the University to destroy records upon completion of use, is subject to the provisions of the Oregon Public Records law.

49. EXECUTION AND COUNTERPARTS. This Contract may be executed in counterparts, and via facsimile or electronically transmitted signature (i.e. emailed scanned true and correct copy of the signed Contract), each of which will be considered an original and all of which together will constitute one and the same Contract.

50. ORDER OF PRECEDENCE. These Terms and Conditions are for the provision of goods or services to the University. University Standard Terms and Conditions are referenced in the Purchase Order (PO) or any associated contract incorporating these Terms and Conditions. In the event of a conflict between these Terms and Conditions and such PO or contract, these Terms and Conditions take precedence, unless otherwise required by law or a provision is expressly excluded in the associated PO or contract by precise and specific reference to such provision. Whenever possible all Terms and Conditions are to be integrated. By signing this Contract, the Contractor agrees that, in the event of a conflict, all the terms and conditions of this PSC superseded all preprinted Terms and Conditions on any forms used by the Contractor.

51. TAX COMPLIANCE CERTIFICATION: By signature on the Contract, the authorized representative of the Contractor, as required by ORS 305.385(6), hereby certifies, under penalty of perjury, that the Contractor is not, to the best of the undersigned's knowledge, in violation of any Oregon tax laws. For purposes of this certification, (4) "Tax" means a state tax imposed by ORS 401.792 to 401.816 and 320.005 to 320.150 and ORS chapters 118, 314, 316, 317, 318, 321 and 323 and the elderly rental assistance program under ORS 310.630 to 310.706 and local taxes administered by the Department of Revenue under ORS 305.620. [1987 c.843 §6; 1997 c.99 §35; 1997 c.170 §16; 2005 c.94 §21]

**SOUTHERN OREGON UNIVERSITY (a University with
a Governing Board)**

**GENERAL CONDITIONS
FOR PUBLIC IMPROVEMENT
CONTRACTS**

Feb 9, 2016

INSTRUCTIONS: The attached **Southern Oregon University (SOU) General Conditions for Public Improvement Contracts ("SOU Public Improvement General Conditions")** apply to all designated public improvement contracts. Changes to the SOU Public Improvement General Conditions (including any additions, deletions or substitutions) should only be made by attaching Public Improvement Supplemental General Conditions. The text of these SOU Public Improvement General Conditions should not otherwise be altered.

Note: All references to Oregon Administrative Rules ("OARs") previously found in Chapter 580 have been transferred to SOU by operation of law by Senate Bill 270 (2013). They are available at: <http://www.sou.edu/policies/oar-ors.html>

TABLE OF SECTIONS

SECTION A
GENERAL PROVISIONS

- A.1 DEFINITION OF TERMS
- A.2 SCOPE OF WORK
- A.3 INTERPRETATION OF CONTRACT DOCUMENTS
- A.4 EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE
- A.5 INDEPENDENT CONTRACTOR STATUS
- A.6 RETIREMENT SYSTEM STATUS AND TAXES
- A.7 GOVERNMENT EMPLOYMENT STATUS

SECTION B
ADMINISTRATION OF THE CONTRACT

- B.1 OWNER'S ADMINISTRATION OF THE CONTRACT
- B.2 CONTRACTOR'S MEANS AND METHODS
- B.3 MATERIALS AND WORKMANSHIP
- B.4 PERMITS
- B.5 COMPLIANCE WITH GOVERNMENT REGULATIONS
- B.6 SUPERINTENDENCE
- B.7 INSPECTION
- B.8 SEVERABILITY
- B.9 ACCESS TO RECORDS
- B.10 WAIVER
- B.11 SUBCONTRACTS AND ASSIGNMENT
- B.12 SUCCESSORS IN INTEREST
- B.13 OWNER'S RIGHT TO DO WORK
- B.14 OTHER CONTRACTS
- B.15 GOVERNING LAW
- B.16 LITIGATION
- B.17 ALLOWANCES
- B.18 SUBMITTALS, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- B.19 SUBSTITUTIONS
- B.20 USE OF PLANS AND SPECIFICATIONS
- B.21 FUNDS AVAILABLE AND AUTHORIZED
- B.22 NO THIRD PARTY BENEFICIARIES

SECTION C
WAGES AND LABOR

- C.1 MINIMUM WAGES RATES ON PUBLIC WORKS
- C.2 PAYROLL CERTIFICATION AND FEE REQUIREMENTS, ADDITIONAL RETAINAGE
- C.3 PROMPT PAYMENT AND CONTRACT CONDITIONS
- C.4 PAYMENT FOR MEDICAL CARE
- C.5 HOURS OF LABOR

SECTION D
CHANGES IN THE WORK

- D.1 CHANGES IN THE WORK
- D.2 DELAYS
- D.3 CLAIMS REVIEW PROCESS

SECTION E
PAYMENTS

- E.1 SCHEDULE OF VALUES
- E.2 APPLICATIONS FOR PAYMENT
- E.3 PAYROLL CERTIFICATION REQUIREMENT
- E.4 DUAL PAYMENT SOURCES
- E.5 RETAINAGE
- E.6 FINAL PAYMENT

SECTION F
JOB SITE CONDITIONS

- F.1 USE OF PREMISES
- F.2 PROTECTION OF WORKERS, PROPERTY, AND THE PUBLIC
- F.3 CUTTING AND PATCHING
- F.4 CLEANING UP
- F.5 ENVIRONMENTAL CONTAMINATION
- F.6 ENVIRONMENTAL CLEAN-UP
- F.7 FORCE MAJEURE

SECTION G
INDEMNITY, BONDING AND INSURANCE

- G.1 RESPONSIBILITY FOR DAMAGES/INDEMNITY
- G.2 PERFORMANCE AND PAYMENT SECURITY, PUBLIC WORKS BOND
- G.3 INSURANCE

SECTION H
SCHEDULE OF WORK

- H.1 CONTRACT PERIOD
- H.2 SCHEDULE
- H.3 PARTIAL OCCUPANCY OR USE

SECTION I
CORRECTION OF WORK

- I.1 CORRECTIONS OF WORK BEFORE FINAL PAYMENT
- I.2 WARRANTY WORK

SECTION J
SUSPENSION AND/OR TERMINATION OF THE WORK

- J.1 OWNER'S RIGHT TO SUSPEND THE WORK
- J.2 CONTRACTOR'S RESPONSIBILITIES
- J.3 COMPENSATION FOR SUSPENSION
- J.4 OWNER'S RIGHT TO TERMINATE CONTRACT
- J.5 TERMINATION FOR CONVENIENCE
- J.6 ACTION UPON TERMINATION

SECTION K
CONTRACT CLOSE-OUT

- K.1 RECORD DOCUMENTS
- K.2 OPERATION AND MAINTENANCE MANUALS
- K.3 COMPLETION NOTICES
- K.4 TRAINING
- K.5 EXTRA MATERIALS
- K.6 ENVIRONMENTAL CLEAN-UP
- K.7 CERTIFICATE OF OCCUPANCY
- K.8 OTHER CONTRACTOR RESPONSIBILITIES
- K.9 SURVIVAL

SOUTHERN OREGON UNIVERSITY (a University with a Governing Board)
GENERAL CONDITIONS FOR PUBLIC IMPROVEMENT CONTRACTS
("SOU Public Improvement General Conditions")

SECTION A
GENERAL PROVISIONS

A.1 DEFINITION OF TERMS

In the Contract Documents the following terms shall be as defined below:

APPLICABLE LAWS, means federal, state and local laws, codes, rules, regulations and ordinances applicable to the Work and to the Contract.

ARCHITECT/ENGINEER, means the Person appointed by the Owner to make drawings and specifications and, to provide contract administration of the Work contemplated by the Contract to the extent provided herein or by supplemental instruction of Owner (under which Owner may delegate responsibilities to the Architect/Engineer), in accordance with ORS Chapter 671 (Architects) or ORS Chapter 672 (Engineers) and administrative rules adopted thereunder.

BID, means an offer binding on the Bidder and submitted in response to an Instructions to Bidders or a proposal in connection with a Request for Proposals.

BIDDER, means an Entity that submits a Bid in response to Instructions to Bidders or a proposer in connection with a Request for Proposals.

CHANGE ORDER, means a written order which, when fully executed by the Parties to this Contract, constitutes a change to the Contract Documents. Change Orders shall be issued in accordance with the changes provisions in Section D and, if applicable, establish a Contract Price or Contract Time adjustment. A Change Order shall not be effective until executed as a Change Order.

CLAIM, means a demand by Contractor pursuant to Section D.3 for review of the denial of Contractor's initial request for an adjustment of Contract terms, payment of money, extension of Contract Time or other relief, submitted in accordance with the requirements and within the time limits established for review of Claims in these SOU Public Improvement General Conditions.

CONSTRUCTION CHANGE DIRECTIVE, means a written order by the Owner to the Contractor requiring a change in the Work within the general scope of the Contract Documents, issued under the changes provisions of Section D.

CONTRACT, means the written agreement between the Owner and the Contractor comprised of the Contract Documents which describe the Work to be done and the obligations between the parties.

CONTRACT DOCUMENTS, means the Solicitation Document and addenda thereto, Instructions to Bidders, Supplemental Instructions to Bidders, the SOU Public Improvement Contract, SOU Public Improvement General Conditions, Public Improvement Supplemental General Conditions, if any, the accepted Bid, Plans, Specifications, Change Orders, and Construction Change Directives.

CONTRACT PERIOD, as set forth in the Contract Documents, means the total period of time beginning with the full execution of this Contract and, if applicable, the issuance of a Notice to Proceed and concluding upon Final Completion.

CONTRACT PRICE, means the total of the awarded Bid amount, as increased or decreased by the price of approved alternates, as indicated in the Contract Documents.

CONTRACT TIME, means any incremental period of time allowed

under the Contract to complete any portion of the Work as reflected in the project schedule.

CONTRACTOR, means the Person awarded the Contract for the Work contemplated.

DAYS, are calendar days, including weekdays, weekends and holidays, unless otherwise specified.

DIRECT COSTS, means, unless otherwise provided in the Contract Documents, the cost of materials, including sales tax, cost of delivery; cost of labor, including social security, Medicare and unemployment insurance, and fringe benefits required by agreement or custom; worker's compensation insurance; project specific insurance (including, without limitation, Builder's Risk Insurance and Builder's Risk Installation Floater); bond premiums, rental cost of equipment, and machinery required for execution of the Work; Owner's costs to correct defective Work; and the additional costs of field personnel directly attributable to the Work.

FINAL COMPLETION, means the final completion of all requirements under the Contract, including Contract Closeout as described in Section K but excluding Warranty Work as described in Section I.2, and the final payment and release of all retainage, if any, released.

FORCE MAJEURE, means an act, event or occurrence caused by fire, riot, war, acts of God, nature, sovereign, or public enemy, strikes, freight embargoes or any other act, event or occurrence that is beyond the control of the party to this Contract who is asserting Force Majeure.

MWESB REPORT, means an accurate report by the Contractor to the Owner identifying all Minority, Women and Emerging Small Business (MWESB) enterprises, as those terms are defined in ORS 200.005, receiving contracts throughout the course of the Work. An initial MWESB report is required (see Section E.2.9) and MWESB Reports are required annually (see Section E.2.9) and as a condition of final payment (see Section K.1). The initial report shall be in the form required by SOU and as posted from time to time on the SOU website and shall include the total number of contracts and subcontracts awarded to MWESB enterprises and the dollar value of their respective contracts and subcontracts. The annual reports shall include the total number of contracts and subcontracts awarded to MWESB enterprises, the dollar value of each, and the expenditure toward each contract and subcontract during the previous twelve (12) months. The final report shall include the total number of contracts and subcontracts awarded to MWESB enterprises and the dollar value of their respective contracts and subcontracts including all Change Orders incorporated during the course of the project. The reports shall only include enterprises certified with the State of Oregon as MWESB enterprises and shall include individual identification of each enterprise as a Minority business enterprise, a Women business enterprise, and/or an Emerging Small Business Enterprise, as applicable.

NOTICE TO PROCEED, means the official written notice from the Owner stating that the Contractor is to proceed with the Work defined in the Contract Documents. Notwithstanding the Notice to Proceed, Contractor shall not be authorized to proceed with the Work until all initial Contract requirements, including the Contract, performance bond and payment bond, and certificates of insurance, have been fully executed and submitted to Owner in a suitable form.

OVERHEAD, means those items which may be included in the Contractor's markup (general and administrative expense and profit only) and that shall not be charged as Direct Cost of the Work,

including without limitation such Overhead expenses as wages or salary of personnel above the level of foreman (i.e., superintendents and project managers), expenses of Contractor's offices and supplies at the job site (e.g. job trailer) and at Contractor's principal place of business and including expenses of personnel staffing the job site office and Contractor's principal place of business, and Commercial General Liability Insurance and Automobile Liability Insurance.

OWNER, means Southern Oregon University. Owner may elect, by written notice to Contractor, to delegate certain duties to more than one party, including without limitation, to an Architect/Engineer. However, nothing in these SOU Public Improvement General Conditions is intended to abrogate the separate design professional responsibilities of Architects under ORS Chapter 671 or of Engineers under ORS Chapter 672.

PERSON, means a natural person or entity doing business as a sole proprietorship, a partnership, a joint venture, a corporation, a limited liability company or partnership, or any other entity possessing the legal capacity to contract.

PLANS, means the drawings which show the location, type, dimensions, and details of the Work to be done under the Contract.

PUNCH LIST, means the list of Work yet to be completed or deficiencies which need to be corrected in order to achieve Final Completion of the Contract.

RECORD DOCUMENT, means the as-built Plans, Specifications, testing and inspection records, product data, samples, manufacturer and distributor/supplier warranties evidencing transfer of ownership to Owner, operational and maintenance manuals, shop drawings, Construction Change Directives, MWESB Reports, correspondence, certificate(s) of occupancy, and other documents listed in Subsection B.9.1 of these SOU Public Improvement General Conditions, recording all Services performed.

SOLICITATION DOCUMENT, means Instructions to Bidders or Bidders or a Request for Proposal or a Request for Quotes.

SPECIFICATION, means any description of the physical or functional characteristics of the Work, or of the nature of a supply, service or construction item. Specifications may include a description of any requirement for inspecting, testing or preparing a supply, service or construction item for delivery and the quantities or qualities of materials to be furnished under the Contract. Specifications generally will state the results or products to be obtained and may, on occasion, describe the method and manner of doing the Work to be performed. Specifications may be incorporated by reference and/or may be attached to the Contract.

SUBCONTRACTOR, means a Person having a direct contract with the Contractor, or another Subcontractor, to perform one or more items of the Work.

SUBSTANTIAL COMPLETION, means the date when the Owner accepts in writing the construction, alteration or repair of the improvement to real property constituting the Work or any designated portion thereof as having reached that state of completion when it may be used or occupied for its intended purpose. Substantial Completion of facilities with operating systems occurs only after thirty (30) continuous Days of successful, trouble-free operation of the operating systems as provided in Section K.4.2.

SUBSTITUTIONS, means items that in function, performance, reliability, quality, and general configuration are the same or better than the product(s) specified. Approval of any substitute item shall be solely determined by the Owner. The decision of the Owner is final.

PUBLIC IMPROVEMENT SUPPLEMENTAL GENERAL CONDITIONS, means those conditions that remove from, add to, or modify these SOU Public Improvement General Conditions. Public Improvement Supplemental General Conditions may be included in the Solicitation Document or may be a separate attachment to the Contract.

WORK, means the furnishing of all materials, equipment, labor, transportation, services and incidentals necessary to successfully complete any individual item or the entire Contract and the carrying out of duties and obligations imposed by the Contract Documents.

A.2 SCOPE OF WORK

The Work contemplated under this Contract includes all labor, materials, transportation, equipment and services for, and incidental to, the completion of all construction work in connection with the project described in the Contract Documents. The Contractor shall perform all Work necessary so that the project can be legally occupied and fully used for the intended use as set forth in the Contract Documents.

A.3 INTERPRETATION OF CONTRACT DOCUMENTS

- A.3.1 Unless otherwise specifically defined in the Contract Documents, words which have well-known technical meanings or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings. Contract Documents are intended to be complementary. Whatever is called for in one, is interpreted to be called for in all. However, in the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following descending order of precedence:
- (a) Contract Change Orders and Construction Change Directives, with those of later date having precedence over those of an earlier date;
 - (b) The SOU Public Improvement Contract;
 - (c) The SOU Public Improvement General Conditions;
 - (d) Division One (General Requirements) of the Specifications;
 - (e) Detailed Schedules of finishes, equipment and other items included in the Specifications;
 - (f) Plans and Specifications (other than Division One and the Detailed Schedules to the Specifications);
 - (g) Large-scale drawings on Plans;
 - (h) Small-scale drawings on Plans;
 - (i) Dimension numbers written on Plans which shall prevail and take precedence over dimensions scaled from Plans;
 - (j) The Solicitation Document, and any addenda thereto;
 - (k) The accepted Bid.
- A.3.2 In the case of an inconsistency between Plans and Specifications or within either document not clarified by addendum, the better quality or greater quantity of Work shall be provided in accordance with the Owner's interpretation in writing.
- A.3.3 If the Contractor finds discrepancies in, or omissions from the Contract Documents, or if the Contractor is in doubt as to their meaning, the Contractor shall at once notify the Owner. Matters concerning and interpretation of requirements of the Contract Documents will be decided by the Owner, who may delegate that duty in some instances to the Architect/Engineer. Responses to Contractor's requests for interpretation of Contract

Documents will be made in writing by Owner (or the Architect/Engineer) within any time limits agreed upon or otherwise with reasonable promptness. Interpretations and decisions of the Owner (or Architect/Engineer) will be consistent with the intent of and reasonably inferable from the Contract Documents. Contractor shall not proceed without direction in writing from the Owner (or Architect/Engineer).

- A.3.4 References to standard specifications, manuals, codes of any technical society, organization or association, to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, laws or regulations in effect in the jurisdiction where the project is occurring on the first published date of the Solicitation Document, except as may be otherwise specifically stated.

A.4 EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE

- A.4.1 It is understood that the Contractor, before submitting a Bid, has made a careful examination of the Contract Documents; has become fully informed as to the quality and quantity of materials and the character of the Work required; and has made a careful examination of the location and conditions of the Work and the sources of supply for materials. The Owner will in no case be responsible for any loss or for any unanticipated costs that may be suffered by the Contractor as a result of the Contractor's failure to acquire full information in advance in regard to all conditions pertaining to the Work. No oral agreement or conversation with any officer, agent, or personnel of the Owner, or with the Architect/Engineer, either before or after the execution of this Contract, shall affect or modify any of the terms or obligations herein contained.

- A.4.2 Should the Plans or Specifications fail to particularly describe the materials, kind of goods, or details of construction of any aspect of the Work, Contractor shall have the duty to make inquiry of the Owner and Architect/Engineer as to what is required prior to performance of the Work. Absent Specifications to the contrary, the materials or processes that would normally be used to produce first quality finished Work shall be considered a part of the Contract requirements.

- A.4.3 Any design errors or omissions noted by the Contractor shall be reported promptly to the Owner, including without limitation, any nonconformity with Applicable Laws.

- A.4.4 If the Contractor believes that adjustments to cost or Contract Time is involved because of clarifications or instructions issued by the Owner (or Architect/Engineer) in response to the Contractor's notices or requests for information, the Contractor must submit a written request to the Owner, setting forth the nature and specific extent of the request, including all time and cost impacts against the Contract as soon as possible, but no later than thirty (30) Days after receipt by Contractor of the clarifications or instructions issued. If the Owner denies Contractor's request for additional compensation, additional Contract Time, or other relief that Contractor believes results from the clarifications or instructions, the Contractor may proceed to file a Claim under Section D.3, Claims Review Process. If the Contractor fails to perform the obligations of Sections A.4.1 to A.4.3, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations.

A.5 INDEPENDENT CONTRACTOR STATUS

The service or services to be performed under this Contract are those of an independent contractor as defined in ORS 670.600. Contractor represents and warrants that it is not an officer, employee or agent of the Owner as those terms are used in ORS 30.265.

A.6 RETIREMENT SYSTEM STATUS AND TAXES

Contractor represents and warrants that it is not a contributing member of the Public Employees' Retirement System and will be responsible for any federal or state taxes applicable to payment received under this Contract. Contractor will not be eligible for any benefits from these Contract payments of federal Social Security, employment insurance, workers' compensation or the Public Employees' Retirement System, except as a self-employed individual. Unless the Contractor is subject to backup withholding, Owner will not withhold from such payments any amount(s) to cover Contractor's federal or state tax obligations.

A.7 GOVERNMENT EMPLOYMENT STATUS

- A.7.1 If this payment is to be charged against federal funds, Contractor represents and warrants that it is not currently employed by the Federal Government. This does not preclude the Contractor from holding another contract with the Federal Government.

- A.7.2 The Contractor represents and warrants that Contractor is not an employee of the State of Oregon for purposes of performing Work under this Contract.

SECTION B ADMINISTRATION OF THE CONTRACT

B.1 OWNER'S ADMINISTRATION OF THE CONTRACT

- B.1.1 The Owner shall administer the Contract as described in the Contract Documents (1) during construction (2) until final payment is due and (3) during the one-year period for correction of Work. The Owner will act as provided in the Contract Documents, unless modified in writing in accordance with other provisions of the Contract. In performing these tasks, the Owner may rely on the Architect/Engineer or other consultants to perform some or all of these tasks.
- B.1.2 The Owner will visit the site at intervals appropriate to the stage of the Contractor's operations (1) to become generally familiar with and to keep the Owner informed about the progress and quality of the portion of the Work completed, (2) to endeavor to guard the Owner against defects and deficiencies in the Work, and (3) to determine in general if Work is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. The Owner will not make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Owner will neither have control over or charge of, nor be responsible for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work.
- B.1.3 Except as otherwise provided in the Contract Documents or when direct communications have been specifically authorized, the Owner and Contractor shall communicate with each other about matters arising out of or relating to the Contract. Communications by and with the Architect/Engineer's consultants shall be through the Architect/Engineer. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.
- B.1.4 Based upon the Architect/Engineer's evaluations of the Contractor's Application for Payment, or unless otherwise stipulated by the Owner, the Architect/Engineer will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

B.2 CONTRACTOR'S MEANS AND METHODS; MITIGATION OF IMPACTS

B.2.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures.

B.2.1 Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures.

B.2.2 The Contractor is responsible to protect and maintain the Work during the course of construction and to mitigate any adverse impacts to the project, including those caused by authorized changes, which may affect cost, schedule, or quality. Should the Contractor request the assistance of Owner in the performance of any Work included in the Contract Documents, and should Owner, at its discretion, agree to provide such assistance, Owner may provide such assistance by using its own forces or by using another contractor. If Owner performs Work using Owner's own forces, Contractor shall pay Owner at the rate of one and one-half (1½) times the standard hourly rate of Owner's forces, plus related overhead and any direct non-salary costs. If Owner performs the Work using another contractor, Contractor shall pay Owner the amount of Owner's direct costs billed by the other contractor for the Work performed, plus the direct salary costs and related overhead and direct non-salary expenses of Owner's forces who are required to monitor that contractor's work. Work performed by Owner using Owner's own forces or those of another contractor shall not affect the Contractor's contractual duties under these provisions, including warranty provisions.

B.2.3 The Contractor is responsible for the actions of all its personnel, laborers, suppliers, and Subcontractors on the project. The Contractor shall enforce strict discipline and good order among Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of persons who are unfit or unskilled for the tasks assigned to them.

B.3 MATERIALS AND WORKMANSHIP

B.3.1 The intent of the Contract Documents is to provide for the construction and completion in every detail of the Work described. All Work shall be performed in a professional manner and unless the means or methods of performing a task are specified elsewhere in the Contract Documents, Contractor shall employ methods that are generally accepted and used by the industry, in accordance with industry standards.

B.3.2 The Contractor is responsible to perform the Work as required by the Contract Documents. Defective Work shall be corrected at the Contractor's expense.

B.3.3 Work done and materials furnished shall be subject to inspection and/or observation and testing by the Owner to determine if they conform to the Contract Documents. Inspection of the Work by the Owner does not relieve the Contractor of responsibility for the Work in accordance with the Contract Documents.

B.3.4 The Contractor shall furnish adequate facilities, as required, for the Owner to have safe access to the Work including, without

limitation, walkways, railings, ladders, tunnels, and platforms. Producers, suppliers, and fabricators shall also provide proper facilities and access to their facilities.

B.3.5 The Contractor shall furnish Samples of materials for testing by the Owner and include the cost of the Samples in the Contract Price.

B.4 PERMITS

Contractor shall obtain and pay for all necessary permits and licenses, except for those specifically excluded in the Supplemental General Conditions, for the construction of the Work, for temporary obstructions, enclosures, opening of streets for pipes, walls, utilities, environmental Work, etc., as required for the project. Owner shall obtain and pay for the general building permit and pay for any specialty permits required for the Work. Contractor shall be responsible for all violations of the law, in connection with the construction or caused by obstructing streets, sidewalks or otherwise. Contractor shall give all requisite notices to public authorities. The Contractor shall pay all royalties and license fees. The Contractor shall defend all suits or claims for infringement of any patent or other proprietary rights and save harmless and blameless from loss, on account thereof, the State of Oregon, Southern Oregon University and its departments, divisions, trustees, members and employees.

B.5 COMPLIANCE WITH GOVERNMENT REGULATIONS

B.5.1 The Contractor shall comply with Applicable Laws pertaining to the Work and the Contract. Failure to comply with such requirements shall constitute a breach of Contract and shall be grounds for Contract termination. Without limiting the generality of the foregoing, Contractor expressly agrees to comply with the following, as applicable:

(i) Title VI and VII of Civil Rights Act of 1964, as amended; (ii) Section 503 and 504 of the Rehabilitation Act of 1973, as amended; (iii) the Health Insurance Portability and Accountability Act of 1996; (iv) the Americans with Disabilities Act of 1990, as amended; (v) ORS Chapter 659A; as amended; (vi) all regulations and administrative rules established pursuant to the foregoing laws; and (vii) all other applicable requirements of federal and state civil rights and rehabilitation statutes, rules and regulations.

B.5.2 The Contractor shall comply with all applicable requirements of federal and state civil rights and rehabilitation statutes, rules and regulations, and

(a) Contractor shall not discriminate against Disadvantaged, Minority, Women or Emerging Small Business enterprises, as those terms are defined in ORS 200.005, or a business enterprise that is owned or controlled by or that employs a disabled veteran, as that term is defined in ORS 408.225, in the awarding of subcontracts.

(b) Contractor shall maintain, in current and valid form, all licenses and certificates required by Applicable Laws or this Contract when performing the Work.

B.5.3 Unless contrary to federal law, Contractor shall certify that it shall not accept a bid from Subcontractors to perform Work as described in ORS 701.005 under this Contract unless such Subcontractors are registered with the Construction Contractors Board in accordance with ORS 701.035 to 701.055 at the time they submit their bids to the Contractor.

B.5.4 Unless contrary to federal law, Contractor shall certify that each landscape contractor, as defined in ORS 671.520(2), performing Work under this Contract holds a valid landscape contractor's license issued pursuant to ORS 671.560.

B.5.5 The following notice is applicable to Contractors who perform excavation Work. "ATTENTION: Oregon law requires you to follow rules adopted by the Oregon Utility

Notification Center. Those rules are set forth in OAR 952-001-0010 through OAR 952-001-0090. You may obtain copies of the rules by calling the center at (503)232-1987.”

- B.5.6 Failure to comply with any or all of the requirements of B.5.1 through B.5.5 shall be a breach of Contract and constitute grounds for Contract termination. Damages or costs resulting from such noncompliance shall be the responsibility of Contractor.

B.6 SUPERINTENDENCE

Contractor shall keep on the site, during the progress of the Work, a competent superintendent and any necessary assistants who shall be satisfactory to the Owner and who shall represent the Contractor on the site. Directions given to the superintendent by the Owner shall be confirmed in writing to the Contractor.

B.7 INSPECTION

- B.7.1 Owner shall have access to the Work at all times.
- B.7.2 Inspection of the Work will be made by the Owner at its discretion. The Owner will have authority to reject Work that does not conform to the Contract Documents. Any Work found to be not in conformance with the Contract Documents, in the discretion of the Owner, shall be removed and replaced at the Contractor's expense.
- B.7.3 The Contractor shall make or obtain at the appropriate time all tests, inspections and approvals of portions of the Work required by the Contract Documents or by Applicable Laws or orders of public authorities having jurisdiction. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work. The Contractor shall give the Owner timely notice of when and where tests and inspections are to be made so that the Owner may be present for such procedures. Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Owner.
- B.7.4 As required by the Contract Documents, Work done or material used without required inspection or testing and/or without providing timely notice to the Owner may be ordered removed at the Contractor's expense.
- B.7.5 If directed to do so any time before the Work is accepted, the Contractor shall uncover portions of the completed Work for inspection. After inspection, the Contractor shall restore such portions of Work to the standard required by the Contract. If the Work uncovered is unacceptable or was done without required testing or inspection or sufficient notice to the Owner, the uncovering and restoration shall be done at the Contractor's expense. If the Work uncovered is acceptable and was done with sufficient notice to the Owner, the uncovering and restoration will be paid for pursuant to a Change Order.
- B.7.6 If any testing or inspection reveals failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Owner's and Architect/Engineer's services and expenses, shall be at the Contractor's expense.
- B.7.7 When the United States government participates in the cost of the Work, or the Owner has an agreement with other public or private organizations, or if any portion of the Work is being performed for a third party or in close proximity to third party facilities, representatives of these organizations shall have the right to inspect the Work affecting their interests or property.

SOU Public Improvement General Conditions (2/9/2016)

Their right to inspect shall not make them a party to the Contract and shall not interfere with the rights of the parties of the Contract. Instructions or orders of such parties shall be transmitted to the Contractor, through the Owner.

B.8 SEVERABILITY

If any provision of this Contract is declared by a court to be illegal or in conflict with any law, the validity of the remaining terms and provisions shall not be affected and the rights and obligations of the parties shall be construed and enforced as if the Contract did not contain the particular provision held to be invalid.

B.9 ACCESS TO RECORDS

- B.9.1 The Contractor shall keep, at all times on the Work site, one record copy of the complete Contract Documents, including the Plans, Specifications, Construction Change Directives and addenda, in good order and marked currently to record field changes and selections made during construction, and one record copy of Shop Drawings, Product Data, Samples and similar submittals, and shall at all times give the Owner access thereto.
- B.9.2 The Contractor shall retain and the Owner and its duly authorized representatives shall have access, for a period not less than ten (10) years, to all Record Documents, financial and accounting records, and other books, documents, papers and records of Contractor which are pertinent to the Contract, including records pertaining to Overhead and indirect costs, for the purpose of making audit, examination, excerpts and transcripts. If for any reason, any part of the Work or this Contract shall be subject to litigation, Contractor shall retain all such records until all litigation is resolved and Contractor shall continue to provide Owner and/or its agents with full access to such records until such time as all litigation is complete and all periods for appeal have expired and full and final satisfaction of any judgment, order or decree is recorded and Owner receives a record copy of documentation from Contractor.

B.10 WAIVER

Failure of the Owner to enforce any provision of this Contract shall not constitute a waiver or relinquishment by the Owner of the right to such performance in the future nor of the right to enforce any other provision of this Contract.

B.11 SUBCONTRACTS AND ASSIGNMENT

- B.11.1 The Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound by the terms and conditions of these SOU Public Improvement General Conditions, and to assume toward the Contractor all of the obligations and responsibilities which the Contractor assumes toward the Owner thereunder, unless (1) the same are clearly inapplicable to the subcontract at issue because of legal requirements or industry practices, or (2) specific exceptions are requested by Contractor and approved in writing by Owner. Where appropriate, Contractor shall require each Subcontractor to enter into similar agreements with sub-subcontractors at any level.
- B.11.2 At Owner's request, Contractor shall submit to Owner prior to their execution either Contractor's form of subcontract, or the subcontract to be executed with any particular Subcontractor. If Owner disapproves such form, Contractor shall not execute the form until the matters disapproved are resolved to Owner's satisfaction. Owner's review, comment upon or approval of any such form shall not relieve Contractor of its obligations under this Agreement or be deemed a waiver of such obligations of Contractor.
- B.11.3 The Contractor shall not assign, sell, or transfer its rights, or delegate its responsibilities under this Contract, in whole or

in part, without the prior written approval of the Owner. No such written approval shall relieve Contractor of any obligations of this Contract, and any transferee shall be considered the agent of the Contractor and bound to perform in accordance with the Contract Documents. Contractor shall remain liable as between the original parties to the Contract as if no assignment had occurred.

B.12 SUCCESSORS IN INTEREST

The provisions of this Contract shall be binding upon and shall accrue to the benefit of the parties to the Contract and their respective permitted successors and assigns.

B.13 OWNER'S RIGHT TO DO WORK

Owner reserves the right to perform other or additional work at or near the project site with other forces than those of the Contractor. If such work takes place within or next to the project site, Contractor shall coordinate work with the other contractors or forces, cooperate with all other contractors or forces, carry out the Work in a way that will minimize interference and delay for all forces involved, place and dispose of materials being used so as not to interfere with the operations of another, and join the Work with the work of the others in an acceptable manner and perform it in proper sequence to that of the others. The Owner will resolve any disagreements that may arise between or among Contractor and the other contractors over the method or order of doing all work (including the Work). In case of unavoidable interference, the Owner will establish work priority (including the Work) which generally will be in the sequence that the contracts were awarded.

B.14 OTHER CONTRACTS

In all cases and at any time, the Owner has the right to execute other contracts related to or unrelated to the Work of this Contract. The Contractor of this Contract shall fully cooperate with any and all other contractors without additional cost to the Owner in the manner described in section B.13.

B.15 GOVERNING LAW

This Contract shall be governed by and construed in accordance with the laws of the State of Oregon without regard to principles of conflict of laws.

B.16 LITIGATION

Any Claim between Owner and Contractor that arises from or relates to this Contract and that is not resolved through the Claims Review Process in Section D.3 shall be brought and conducted solely and exclusively within the Circuit Court of Jackson County for the State of Oregon, unless stated otherwise in the Contract Documents, provided, however, if a Claim must be brought in a federal forum, then it shall be brought and conducted solely and exclusively within the United States District Court for the District of Oregon. In no event shall this section be construed as a waiver by the Owner of any form of defense or immunity, whether sovereign immunity, governmental immunity, immunity based on the Eleventh Amendment to the Constitution of the United States or otherwise, from any claim or from the jurisdiction of any court. CONTRACTOR, BY EXECUTION OF THIS CONTRACT, HEREBY CONSENTS TO THE IN PERSONAM JURISDICTION OF THE COURTS REFERENCED IN THIS SECTION B.16.

B.17 ALLOWANCES

B.17.1 The Contractor shall include in the Contract Price all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct.

B.17.2 Unless otherwise provided in the Contract Documents:

- (a) when finally reconciled, allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- (b) Contractor's costs for unloading and handling at the site, labor, installation costs, Overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Price but not in the allowances;
- (c) whenever costs are more than or less than allowances, the Contract Price shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (i) the difference between actual costs and the allowances under Section B.17.2 (a) and (ii) changes in Contractor's costs under Section B.17.2 (b).
- (d) Unless Owner requests otherwise, Contractor shall provide to Owner a proposed fixed price for any allowance work prior to its performance.

B.18 SUBMITTALS, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

B.18.1 The Contractor shall prepare and keep current, for the Architect's/Engineer's approval (or for the approval of Owner if approval authority has not been delegated to the

Architect/Engineer), a schedule and list of submittals which is coordinated with the Contractor's construction schedule and allows the Architect/Engineer reasonable time to review submittals. Owner reserves the right to finally approve the schedule and list of submittals. Submittals include, without limitation, Shop Drawings, Product Data, and Samples which are described below:

- (a) Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor (including any sub-subcontractor), manufacturer, supplier or distributor to illustrate some portion of the Work.
- (b) Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.
- (c) Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

B.18.2 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required by the Contract Documents the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents. Review of submittals by the Architect/Engineer is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, or for approval of safety precautions or, unless otherwise specifically stated by the Architect/Engineer, of any construction means, methods, techniques, sequences or procedures, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect/Engineer's review of the Contractor's submittals shall not relieve the Contractor of its obligations under the Contract Documents. The Architect/Engineer's approval of a specific item shall not indicate approval of an assembly of which the item is a component. Informational submittals upon which the Architect/Engineer is not expected to take responsive action may be so identified in the Contract Documents. Submittals which are not required by the Contract Documents may be returned by the Architect/Engineer without action.

B.18.3 The Contractor shall review for compliance with the Contract

Documents, approve and submit to the Architect/Engineer Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors. Submittals which are not marked as reviewed for compliance with the Contract Documents and approved by the Contractor may be returned by the Architect/Engineer without action.

- B.18.4 By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.
- B.18.5 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect/Engineer.
- B.18.6 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect/Engineer's review or approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect/Engineer in writing of such deviation at the time of submittal and (i) the Architect/Engineer has given written approval to the specific deviation as a minor change in the Work, or (ii) a Change Order or Construction Change Directive has been executed by Owner authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect/Engineer's review or approval thereof.
- B.18.7 In the event that Owner elects not to have the obligations and duties described under this Section B.18 performed by the Architect/Engineer, or in the event no Architect/Engineer is employed by Owner on the project, all obligations and duties assigned to the Architect/Engineer hereunder shall be performed by the Owner.

B.19 SUBSTITUTIONS

The Contractor may make Substitutions only with the consent of the Owner, after evaluation by the Owner and only in accordance with a Change Order or Construction Change Directive. Substitutions shall be subject to the requirements of the Bid documents. By making requests for Substitutions, the Contractor: represents that the Contractor has personally investigated the proposed substitute product; represents that the Contractor will provide the same warranty for the Substitution that the Contractor would for the product originally specified unless approved otherwise; certifies that the cost data presented is complete and includes all related costs under this Contract including redesign costs, and waives all claims for additional costs related to the Substitution which subsequently become apparent; and will coordinate the installation of the accepted Substitution, making such changes as may be required for the Work to be completed in all respects.

B.20 USE OF PLANS AND SPECIFICATIONS

Plans, Specifications and related Contract Documents furnished to Contractor by Owner or Owner's Architect/Engineer shall be used solely for the performance of the Work under this Contract. Contractor and its Subcontractors and suppliers are authorized to use and reproduce applicable portions of such documents appropriate to the execution of the Work, but shall not claim any ownership or other interest in them beyond the scope of this Contract, and no such interest shall attach. Unless otherwise indicated, all common law, statutory and other reserved rights, in addition to SOU Public Improvement General Conditions (2/9/2016)

copyrights, are retained by Owner.

B.21 FUNDS AVAILABLE AND AUTHORIZED

Owner reasonably believes at the time of entering into this Contract that sufficient funds are available and authorized for expenditure to finance the cost of this Contract within the Owner's appropriation or limitation. Contractor understands and agrees that, to the extent that sufficient funds are not available and authorized for expenditure to finance the cost of this Contract, Owner's payment of amounts under this Contract attributable to Services performed after the last day of the current biennium is contingent on Owner receiving from the Oregon Legislative Assembly appropriations, limitations or other expenditure authority sufficient to allow Owner, in the exercise of its reasonable administrative discretion, to continue to make payments under this Contract.

B.22 NO THIRD PARTY BENEFICIARIES

Owner and Contractor are the only parties to this Contract and are the only parties entitled to enforce its terms. Nothing in this Contract gives, is intended to give, or shall be construed to give or provide any benefit or right, whether directly, indirectly, or otherwise, to third persons unless such third persons are individually identified by name herein and expressly described as intended beneficiaries of the terms of this Contract.

SECTION C WAGES AND LABOR

C.1 MINIMUM WAGE RATES ON PUBLIC WORKS

Contractor shall comply fully with the provisions of ORS 279C.800 through 279C.870. Documents establishing those conditions, as determined by the Commissioner of the Bureau of Labor and Industries (BOLI), are included as attachments to or are incorporated by reference in the Contract Documents. Pursuant to ORS 279C.830(1)(d), Contractor shall pay workers at not less than the specified minimum hourly rate of wage, and shall include that requirement in all subcontracts. If the Work is subject to both the state prevailing wage rate law and the federal Davis-Bacon Act, Contractor shall pay the higher of the applicable state or federal prevailing rate of wage. Contractor shall provide written notice to all workers of the number of hours per day and days per week such workers may be required to work.

C.2 PAYROLL CERTIFICATION AND FEE REQUIREMENTS

- C.2.1 In accordance with ORS 279C.845, the Contractor and every Subcontractor shall submit written certified statements to the Owner, on the form prescribed by the Commissioner of the Bureau of Labor and Industries, certifying the hourly rate of wage paid each worker which the Contractor or the Subcontractor has employed on the project and further certifying that no worker employed on the project has been paid less than the prevailing rate of wage or less than the minimum hourly rate of wage specified in the Contract, which certificate and statement shall be verified by the oath of the Contractor or the Subcontractor that the Contractor or Subcontractor has read the certified statement, that the Contractor or Subcontractor knows the contents of the certified statement, and, that to the Contractor's or Subcontractor's best knowledge and belief, the certified statement is true. The certified statements shall set out accurately and completely the payroll records for the prior week, including the name and address of each worker, the worker's correct classification, rate of pay, daily and weekly number of hours worked, deductions made, and actual wages paid. Certified statements for each week during which the Contractor or Subcontractor has employed a worker on the project shall be submitted once a month, by the fifth business day of the following month. The Contractor and Subcontractors shall preserve the certified statements for a period of ten (10) years from the date of

completion of the Contract.

- C.2.2 Pursuant to ORS 279C.845(7), the Owner shall retain 25 percent of any amount earned by the Contractor on this public works project until the Contractor has filed the certified statements required by section C.2.1. The Owner shall pay to the Contractor the amount retained under this subsection within 14 days after the Contractor files the required certified statements, regardless of whether a Subcontractor has failed to file certified statements.

C.2.3 Pursuant to ORS 279C.845(8), the Contractor shall retain 25 percent of any amount earned by a first-tier Subcontractor on this public works project until the first-tier Subcontractor has filed with the Owner the certified statements required by C.2.1. Before paying any amount retained under this subsection, the Contractor shall verify that the first-tier Subcontractor has filed the certified statement. Within 14 days after the first-tier Subcontractor files the required certified statement the Contractor shall pay the first-tier Subcontractor any amount retained under this subsection.

- C.2.4 In accordance with statutory requirements and administrative rules promulgated by the Commissioner of the Bureau of Labor and Industries, the fee required by ORS 279C.825(1) will be paid by Owner to the Commissioner.

C.3 PROMPT PAYMENT AND CONTRACT CONDITIONS

- C.3.1 As a condition to Owner's performance hereunder, the Contractor shall:

C.3.1.1 Make payment promptly, as due, to all persons supplying to Contractor labor or materials for the prosecution of the Work provided for in this Contract.

C.3.1.2 Pay all contributions or amounts due the State Industrial Accident Fund from such Contractor or Subcontractor incurred in the performance of the Contract.

C.3.1.3 Not permit any lien or claim to be filed or prosecuted against the Owner on account of any labor or material furnished. Contractor will not assign any claims that Contractor has against Owner, or assign any sums due by Owner, to Subcontractors, suppliers, or manufacturers, and will not make any agreement or act in any way to give Subcontractors a claim or standing to make a claim against the Owner.

C.3.1.4 Pay to the Department of Revenue all sums withheld from employees pursuant to ORS 316.167.

C.3.2 As a condition to Owner's performance hereunder, if Contractor fails, neglects or refuses to make prompt payment of any claim for labor or services furnished to the Contractor of a Subcontractor by any person in connection with the project as such claim becomes due, the proper officer(s) representing the Owner may pay the claim and charge the amount of the payment against funds due or to become due Contractor under this Contract. Payment of claims in this manner shall not relieve the Contractor or the Contractor's surety from obligation with respect to any unpaid claims.

C.3.3 The Contractor shall include in each subcontract for property or services entered into by the Contractor and a first-tier subcontractor, including a material supplier, for the purpose of performing a construction contract, a payment clause that obligates the Contractor to pay the first-tier Subcontractor for satisfactory performance under its subcontract within ten (10) Days out of such amounts as are paid to the Contractor by the public contracting agency under such contract.

C.3.4 All employers, including Contractor, that employ subject workers who work under this contract in the State of Oregon shall comply with ORS 656.017 and provide the required Workers' Compensation coverage, unless such employers are exempt under ORS 656.126. Contractor shall ensure that each of its Subcontractors complies with these requirements.

C.4 PAYMENT FOR MEDICAL CARE

As a condition to Owner's performance hereunder, Contractor shall promptly, as due, make payment to any person, partnership, association or corporation furnishing medical, surgical, and hospital care or other needed care and attention, incident to sickness or injury, to the employees of such Contractor, all sums of which the Contractor agrees to pay for such services and all moneys and sums which the Contractor has collected or deducted from the wages of personnel pursuant to any law, contract or agreement for the purpose of providing or paying for such services.

C.5 HOURS OF LABOR

As a condition to Owner's performance hereunder, no person shall be employed to perform Work under this Contract for more than ten (10) hours in any one day or forty (40) hours in any one week, except in cases of necessity, emergency or where public policy absolutely requires it. In such instances, Contractor shall pay the employee at least time and a half pay:

- (a) For all overtime in excess of eight (8) hours a day or forty (40) hours in any one week when the work week is five consecutive Days, Monday through Friday; or
- (b) For all overtime in excess of ten (10) hours a day or forty (40) hours in any one week when the work week is four consecutive Days, Monday through Friday; and
- (c) For all Work performed on Saturday and on any legal holiday specified in ORS 279C.540.

This section C.5 will not apply to Contractor's Work under this Contract to the extent Contractor is currently a party to a collective bargaining agreement with any labor organization.

This Section C.5 shall not excuse Contractor from completion of the Work within the time required under this Contract.

SECTION D CHANGES IN THE WORK

D.1 CHANGES IN WORK

D.1.1 The terms of this Contract shall not be waived, altered, modified, supplemented or amended in any manner whatsoever, without prior written agreement and then only after any necessary approvals have been obtained. A Change Order is required, which shall not be effective until its execution by the parties to this Contract and all approvals required by public contracting laws have been obtained.

D.1.2 It is mutually agreed that changes in Plans, quantities, or details of construction are inherent in the nature of construction and may be necessary or desirable during the course of construction. Within the general scope of this Contract, the Owner may at any time, without notice to the sureties and without impairing the Contract, require changes consistent with this Section D.1. All changes to the Work shall be documented and Change Orders shall be executed under the conditions of the Contract Documents. Such changes may include, but are not limited to:

- (a) Modification of specifications and design.
- (b) Increases or decreases in quantities.
- (c) Increases or decreases to the amount of Work.

- (d) Addition or elimination of any Work item.
- (e) Change in the duration of the project.
- (f) Acceleration or delay in performance of Work.
- (g) Deductive changes.

Deductive changes are those that reduce the scope of the Work, and shall be made by mutual agreement whenever feasible. In cases of suspension or partial termination under Section J, Owner reserves the right to unilaterally impose a deductive change and to self-perform such Work, for which the provisions of B.13 (Owner's Right to Do Work) shall then apply.

Adjustments in compensation shall be made under the provisions of D.1.3, in which costs for deductive changes shall be based upon a Direct Costs adjustment together with the related percentage markup specified for profit, Overhead and other indirect costs, unless otherwise agreed to by Owner.

D.1.3 The Owner and Contractor agree that adjustments to or deletions from the Work shall be administered and compensated according to the following:

- (a) Unit pricing may be utilized at the Owner's option when unit prices or solicitation alternates were provided that established the cost for adjustments to Work, and a binding obligation exists under the Contract on the parties covering the terms and conditions of the adjustment to Work.
- (b) Fixed Fee: If the Owner elects not to utilize unit pricing, or in the event that unit pricing is not available or appropriate, fixed pricing may be used for adjustments to or deletions from the Work. In fixed pricing the basis of payments or total price shall be agreed upon in writing between the parties to the Contract, and shall be established before the Work is done whenever feasible. Notwithstanding the foregoing, the mark-ups set forth in D.1.3(c) shall be utilized in establishing fixed pricing, and such mark-ups shall not be exceeded. Cost and price data relating to adjustments to or deletions from the Work shall be supplied by Contractor to Owner upon request, but Owner shall be under no obligation to make such requests.
- (c) Time and Material: In the event that unit pricing and fixed pricing are not utilized, then adjustments to or deletions from the Work shall be performed on a cost reimbursement basis for Direct Costs. Such Work shall be compensated on the basis of the actual, reasonable and allowable cost of labor, equipment, and material furnished on the Work performed. The Contractor or Subcontractor who performs the Work shall be allowed to add up to ten percent (10%) markup to the Direct Costs as full compensation for profit, Overhead and other indirect costs for Work performed with the Contractor's or Subcontractor's own forces

Each ascending tier Subcontractor or the Contractor that did not perform the Work, will be allowed to add up to five percent (5%) supplemental markup on the Direct Costs of the Work (but not the above allowable markups) covered by a Change Orders. No additional markup shall be permitted for any third tier or greater descending Subcontractor.

Example: \$20,000 of Direct Costs Work performed by a 2nd Tier Subcontractor

	Markup	Allowed Total Fee Plus Markup
General Contractor	5%	\$1,000.00
1 st Tier Sub Contractor	5%	\$1,000.00
2 nd Tier Sub Contractor	10%	\$22,000.00

- (d) Payments made to the Contractor shall be complete compensation for Overhead, profit, and all costs that were incurred by the Contractor or by other forces furnished by the Contractor, including Subcontractors, for adjustments to or deletions from the Work pursuant to a Change Order. Owner may establish a maximum cost for additional Work under this

Section D.1.3, which shall not be exceeded for reimbursement without additional written authorization from Owner in the form of a Change Order. Contractor shall not be required to complete such additional Work without additional authorization.

D.1.4 Any necessary adjustment of Contract Time that may be required as a result of adjustments to or deletions from the Work must be agreed upon by the parties before the start of the revised Work unless Owner authorizes Contractor to start the revised Work before agreement on Contract Time adjustment. Contractor shall submit any request for additional compensation (and additional Contract Time if Contractor was authorized to start Work before an adjustment of Contract Time was approved) as soon as possible but no later than thirty (30) Days after receipt of Owner's request for additional Work. If Contractor's request for additional compensation or adjustment of Contract Time is not made within the thirty (30) Day time limit, Contractor's requests pertaining to that additional Work shall be barred. The thirty (30) Day time limit for making requests shall not be extended for any reason, including without limitation Contractor's claimed inability to determine the amount of additional compensation or adjustment of Contract Time, unless an extension is granted in writing by Owner. If the Owner denies Contractor's request for additional compensation or adjustment of Contract Time, Contractor may proceed to file a Claim under Section D.3, Claims Review Process. No other reimbursement, compensation, or payment will be made, except as provided in Section D.1.5 for impact claims.

D.1.5 If any adjustment to Work under Section D.1.3 causes an increase or decrease in the Contractor's cost of, or the Contract Time required for the performance of any other part of the Work under this Contract, Contractor shall submit a written request to the Owner, setting forth the nature and specific extent of the request, including all time and cost impacts against the Contract as soon as possible, but no later than thirty (30) Days after receipt of Owner's request for adjustments to or deletions from the Work by Contractor.

The thirty (30) Day time limit applies to claims of Subcontractors, suppliers, or manufacturers who may be affected by Owner's request for adjustments to or deletions from the Work and who request additional compensation or an extension of Contract Time to perform; Contractor has responsibility for contacting its Subcontractors, suppliers, or manufacturers within the thirty (30) Day time limit, and including their requests with Contractor's requests. If the request involves Work to be completed by Subcontractors, or materials to be furnished by suppliers or manufacturers, such requests shall be submitted to the Contractor in writing with full analysis and justification for the adjustments to compensation and Contract Time requested. The Contractor shall analyze and evaluate the merits of the requests submitted by Subcontractors, suppliers, and manufacturers to Contractor prior to including those requests and Contractor's analysis and evaluation of those requests with Contractor's requests for adjustments to compensation or Contract Time that Contractor submits to the Owner. Failure of Subcontractors, suppliers, manufacturers or others to submit their requests to Contractor for inclusion with Contractor's requests submitted to Owner within the time period and by the means described in this section shall constitute a waiver of these Subcontractor claims. The Owner will not consider direct requests or claims from Subcontractors, suppliers, manufacturers or others not a party to this Contract. The consideration of such requests and claims under this section does not give any Person not a party to the Contract the right to bring a claim against Owner, whether in this claims process, in litigation, or in any dispute resolution process.

If the Owner denies the Contractor's request for adjustment to compensation or Contract Time, the Contractor may proceed to file a Claim under Section D.3, Claims Review Process.

D.1.6 No request or Claim by the Contractor for additional costs or an adjustment of Contract Time shall be allowed if made after receipt of final payment application under this Contract. Final payment application must be made by Contractor within the time required under Section E.6.4.

D.1.7 It is understood that changes in the Work are inherent in construction of this type. The number of changes, the scope of those changes, and the effect they have on the progress of the original Work cannot be defined at this time. The Contractor is notified that numerous changes may be required and that there will be no compensation made, unless and only to the extent otherwise provided in the Contract Documents, to the Contractor directly related to the number of changes. Each change will be evaluated for extension of Contract Time and increase or decrease in compensation based on its own merit.

D.2.1 DELAYS Delays in construction include "Avoidable Delays", which are defined in Section D.2.1.1, and "Unavoidable Delays", which are defined in Section D.2.1.2. The effect of Avoidable Delays is described in Section D.2.2 and the effect of Unavoidable Delays is described in Section D.2.3.

D.2.1.1 Avoidable Delays include any delays other than Unavoidable Delays, and include delays that otherwise would be considered Unavoidable Delays but that:

- (a) Could have been avoided by the exercise of care, prudence, foresight, and diligence on the part of the Contractor or its Subcontractors.
- (b) Affect only a portion of the Work and do not necessarily prevent or delay the prosecution of neither other parts of the Work nor the completion of the whole Work within the Contract Time.
- (c) Do not impact activities on the accepted critical path schedule.
- (d) Are associated with the reasonable interference of other contractors employed by the Owner that do not necessarily prevent the completion of the whole Work within the Contract Time.

D.2.1.2 Unavoidable Delays include delays other than Avoidable Delays that are:

- (a) To the extent caused by any actions of the Owner, or any other employee or agent of the Owner, or by separate contractor employed by the Owner.
- (b) To the extent caused by any site conditions which differ materially from what was represented in the Contract Documents or from conditions that would normally be expected to exist and be inherent to the construction activities defined in the Contract Documents. The Contractor shall notify the Owner immediately of differing site conditions before the area has been disturbed. The Owner will investigate the area and make a determination as to whether or not the conditions differ materially from either the conditions stated in the Contract Documents or those which could reasonably be expected in execution of this particular Contract. If Contractor and the Owner agree that a differing site condition exists, any adjustment to compensation or Contract Time will be determined based on the process set forth in Section D.1.5 for adjustments to or deletions from Work. If the Owner disagrees that a differing site condition exists and denies Contractor's request for additional compensation or Contract Time, Contractor may proceed to file a Claim under Section D.3, Claims Review Process.
- (c) To the extent caused by Force Majeure acts, events or occurrences that could not have been avoided by the

exercise of care, prudence, foresight, and diligence on the part of the Contractor or its Subcontractors.

(d) To the extent caused by adverse weather conditions. Any adverse weather conditions must be substantiated by documentary evidence that weather conditions were abnormal for the specific time period claimed, could not have been anticipated by the Contractor, and adversely impacted the project in a manner that could not be avoided by rescheduling the Work or by implementing measures to protect against the weather so that the Work could proceed. A rain, windstorm, high water, or other natural phenomenon for the specific locality of the Work, which might reasonably have been anticipated from the previous 10-year historical records of the general locality of the Work, shall not be construed as abnormal. The parties agree that rainfall greater than the following levels cannot be reasonably anticipated:

- (i) Daily rainfall equal to, or greater than, 0.50 inch during a month when the monthly rainfall exceeds the normal monthly average by twenty- five percent (25 %) or more.
- (ii) daily rainfall equal to, or greater than, 0.75 inch at any time.

The Office of the Environmental Data Service of the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce nearest the project site shall be considered the official agency of record for weather information.

D.2.2 The Contractor shall not be entitled to additional compensation or additional Contract Time for Avoidable Delays.

D.2.3 In the event of Unavoidable Delays, based on principles of equitable adjustment, Contractor may be entitled to the following:

- (a) Contractor may be entitled to additional compensation or additional Contract Time, or both, for Unavoidable Delays described in Section D.2.1.2 (a) and (b).
- (b) Contractor may be entitled to additional Contract Time for Unavoidable Delays described in Section D.2.1.2(c) and (d).

In the event of any requests for additional compensation or additional Contract Time, or both, as applicable, arising under this Section D.2.3 for Unavoidable Delays, other than requests for additional compensation or additional Contract Time for differing site conditions for which a review process is established under Section D.2.1.2 (b), Contractor shall submit a written notification of the delay to the Owner within two (2) Days of the occurrence of the cause of the delay. This written notification shall state the cause of the potential delay, the project components impacted by the delay, and the anticipated additional Contract Time extension or the additional compensation, or both, as applicable, resulting from the delay. Within seven (7) Days after the cause of the delay has been mitigated, or in no case more than thirty (30) Days after the initial written notification, the Contractor shall submit to the Owner, a complete and detailed request for additional compensation or additional Contract Time, or both, as applicable, resulting from the delay. If the Owner denies Contractor's request for additional compensation or adjustment of Contract Time, the Contractor may proceed to file a Claim under Section D.3, Claims Review Process.

If Contractor does not timely submit the notices required under this Section D.2, then unless otherwise prohibited by law, Contractor's Claim shall be barred.

D.3 CLAIMS REVIEW PROCESS

D.3.1 All Contractor Claims shall be referred to the Owner for review. Contractor's Claims, including Claims for adjustments to compensation or Contract Time, shall be submitted in writing by Contractor to the Owner within five (5) Days after a denial of Contractor's initial request for an adjustment of Contract terms, payment of money, extension of Contract Time or other relief, provided that such initial request has been submitted in accordance with the requirements and within the time limits established in these SOU Public Improvement General Conditions. Within thirty (30) Days after the initial Claim, Contractor shall submit to the Owner a complete and detailed description of the Claim (the "Detailed Notice") that includes all information required by Section D.3.2. Unless the Claim is made in accordance with these time requirements, it shall be waived by Contractor.

D.3.2 The Detailed Notice of the Claim shall be submitted in writing by Contractor and shall include a detailed, factual statement of the basis of the Claim, pertinent dates, Contract provisions which support or allow the Claim, reference to or copies of any documents which support the Claim, the dollar value of the Claim, and the Contract Time adjustment requested for the Claim. If the Claim involves Work to be completed by Subcontractors, the Contractor will analyze and evaluate the merits of the Subcontractor claim prior to forwarding it and that analysis and evaluation to the Owner. The Owner will not consider direct claims from Subcontractors, suppliers, manufacturers, or others not a party to this Contract. Contractor agrees that it will make no agreement, covenant, or assignment, nor will it commit any other act that will permit or assist any Subcontractor, supplier, manufacturer, or other to directly or indirectly make a claim against Owner.

D.3.3 The Owner will review all Claims and take one or more of the following preliminary actions within ten (10) Days of receipt of the Detailed Notice of a Claim: (1) request additional supporting information from the Contractor; (2) inform the Contractor in writing of the time required for adequate review and response; (3) reject the Claim in whole or in part and identify the reasons for rejection; (4) based on principles of equitable adjustment, recommend approval of all or part of the Claim; or (5) propose an alternate resolution.

D.3.4 The Owner's decision shall be final and binding on the Contractor unless appealed by written notice to the Owner within fifteen (15) Days of receipt of the decision. The Contractor must present written documentation supporting the Claim within fifteen (15) Days of the notice of appeal. After receiving the appeal documentation, the Owner shall review the materials and render a decision within thirty (30) Days after receiving the appeal documents.

D.3.5 The decision of the Owner shall be final and binding unless the Contractor delivers to the Owner its request for mediation, which shall be a non-binding process, within fifteen (15) Days of the date of the Owner's decision. The mediation process will be considered to have commenced as of the date the Contractor delivers the request. Both parties acknowledge and agree that participation in mediation is a prerequisite to commencement of litigation of any disputes relating to the Contract. Both parties further agree to exercise their best efforts in good faith to resolve all disputes within sixty (60) Days of the commencement of the mediation through the mediation process set forth herein.

In the event that a lawsuit must be filed within this sixty (60) Day period in order to preserve a cause of action, the parties agree that, notwithstanding the filing, they shall proceed diligently with the mediation to its conclusion prior to actively prosecuting the lawsuit, and shall seek from the Court in which the lawsuit is pending such stays or extensions, including the filing of an answer, as may be necessary to facilitate the mediation process. Further, in the event settlements are reached

on any issues through mediation, the plaintiff shall promptly cause to be entered by the Court a stipulated general judgment of dismissal with prejudice, or other appropriate order limiting the scope of litigation as provided in the settlement.

D.3.6 Should the parties arrive at an impasse regarding any Claims or disputed Claims, it is agreed that the parties shall participate in mediation as specified in Section D.3.5. The mediation process will be considered to have been commenced as of the date one party delivers to the other its request in writing to mediate. The mediator shall be an individual mutually acceptable to both parties, but in the absence of agreement each party shall select a temporary mediator and the temporary mediators shall jointly select the permanent mediator. Each party shall pay its own costs for the time and effort involved in mediation. The cost of the mediator shall be split equally between the two parties. Both parties agree to exercise their best effort in good faith to resolve all disputes in mediation. Participation in mediation is a mandatory requirement of both the Owner and the Contractor. The schedule, time and place for mediation will be mutually acceptable, or, failing mutual agreement, shall be as established by the mediator. The parties agree to comply with Owner's administrative rules governing the confidentiality of mediation, if any, and shall execute all necessary documents to give effect to such confidentiality rules. In any event, the parties shall not subpoena the mediator or otherwise require the mediator to produce records, notes or work product, or to testify in any future proceedings as to information disclosed or representations made in the course of mediation, except to the extent disclosure is required by law.

D.3.7 Unless otherwise directed by Owner, Contractor shall proceed with the Work while any Claim, or mediation or litigation arising from a Claim, is pending. Regardless of the review period or the final decision of the Owner, the Contractor shall continue to diligently pursue the Work as identified in the Contract Documents. In no case is the Contractor justified or allowed to cease or Delay Work, in whole or in part, without a written stop work order from the Owner.

SECTION E PAYMENTS

E.1 SCHEDULE OF VALUES

The Contractor shall submit, at least ten (10) Days prior to submission of its first application for progress payment, a schedule of values ("Schedule of Values") for the contracted Work. This schedule shall provide a breakdown of values for the contracted Work and will be the basis for progress payments. The breakdown shall demonstrate reasonable, identifiable, and measurable components of the Work.

Unless objected to by the Owner, this schedule shall be used as the basis for reviewing Contractor's applications for payment. If objected to by Owner, Contractor shall revise the schedule of values and resubmit the same for approval of Owner.

E.2 APPLICATIONS FOR PAYMENT

E.2.1 Owner shall make progress payments on the Contract monthly as Work progresses, in accordance with the requirements of this Section E.2. Applications for payment shall be based upon estimates of Work completed and the Schedule of Values. As a condition precedent to Owner's obligation to pay, all applications for payment shall be approved by the Owner. A progress payment shall not be considered acceptance or approval of any Work or waiver of any defects therein. Owner shall pay to Contractor interest for overdue invoices at the rate of two-thirds of one percent per month on the progress payment, not including retainage, due the Contractor. Overdue invoices will be those that have not been paid within forty five (45) days from the latest of:

- (a) The date of the receipt of the accurate invoice;
- (b) The date Owner receives the correct application for payment if no invoice is received;
- (c) The date all goods and services have been received; or
- (d) The date a Claim is made certain by agreement of the parties or by operation of law.

Notwithstanding the foregoing, in instances when an application for payment is filled out incorrectly, or when there is any defect or impropriety in any submitted application or when there is a good faith dispute, Owner shall so notify the Contractor within fifteen (15) Days stating the reason or reasons the application for payment is defective or improper or the reasons for the dispute. A defective or improper application for payment, if corrected by the Contractor within seven (7) Days of being notified by the Owner, shall not cause a payment to be made later than specified in this section unless interest is also paid. Payment of interest will be postponed when payment on the principal is delayed because of disagreement between the Owner and the Contractor.

Owner reserves the right, instead of requiring the Contractor to correct or resubmit a defective or improper application for payment, to reject the defective or improper portion of the application for payment and pay the remainder of the application for such amounts which are correct and proper.

Owner, upon written notice to the Contractor, may elect to make payments to the Contractor only by means of Electronic Funds Transfers (EFT) through Automated Clearing House (ACH) payments. If Owner makes this election, the Contractor shall arrange for receipt of the EFT/ACH payments.

E.2.2 Contractor shall submit to the Owner an application for each payment and, if required, receipts or other vouchers showing payments for materials and labor including payments to Subcontractors. Contractor shall include in its application for payment a schedule of the percentages of the various parts of the Work completed, based on the Schedule of Values which shall aggregate to the payment application total, and shall include, on the face of each copy thereof, a certificate in substantially the following form:

"I, the undersigned, hereby certify that the above bill is true and correct, and the payment therefore has not been received.

Signed: _____
Dated: _____"

E.2.3 Generally, applications for payment will be accepted only for materials that have been installed. Under special conditions, applications for payment for stored materials will be accepted at Owner's sole discretion. Such a payment, if made, will be subject to the following conditions:

- (a) The request for stored material shall be submitted at least thirty (30) Days in advance of the application for payment on which it appears. Applications for payment shall be entertained for major equipment, components or expenditures only.
- (b) The Contractor shall submit applications for payment showing the quantity and cost of the material stored.
- (c) The material shall be stored in a bonded warehouse and Owner shall be granted the right to access the material for the purpose of removal or inspection at any time during the Contract Period.
- (d) The Contractor shall name the Owner as co-insured on the insurance policy covering the full value of the property while in the care and custody of the Contractor until it is installed. A

certificate noting this coverage shall be issued to the Owner.

(e) Payments shall be made for materials and equipment only. The submitted amount in the application for payment shall be reduced by the cost of transportation from the storage site to the project site and for the cost of an inspector to verify delivery and condition of the goods at the storage site. The cost of storage and inspection shall be borne solely by the Contractor.

(f) Within sixty (60) Days of the application for payment, the Contractor shall submit evidence of payment covering the material and/or equipment stored and of payment for the storage site.

(g) Payment for stored materials and/or equipment shall in no way indicate acceptance of the materials and/or equipment or waive any rights under this Contract for the rejection of the Work or materials and/or equipment not in conformance with the Contract Documents.

(h) All required documentation shall be submitted with the respective application for payment.

E.2.4 The Owner reserves the right to withhold all or part of a payment, or may nullify in whole or part any payment previously made, to such extent as may be necessary in the Owner's opinion to protect the Owner from loss because of:

- (a) Work that is defective and not remedied, or that has been demonstrated or identified as failing to conform with Applicable Laws or the Contract Documents;
- (b) third party claims filed or evidence reasonably indicating that such claims will likely be filed unless security acceptable to the Owner is provided by the Contractor;
- (c) failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment (in which case Owner may issue checks made payable jointly to Contractor and such unpaid Persons under this provision, or directly to Subcontractors and suppliers at any level under Section C.3.2.1);
- (d) reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Price;
- (e) damage to the Work, or other damage suffered by the Owner or another contractor;
- (f) reasonable evidence that the Work will not be completed within the Contract Time required by the Contract, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;
- (g) failure to carry out the Work in accordance with the Contract Documents; or
- (h) assessment of liquidated damages, when withholding is made for offset purposes.

E.2.5 Subject to the provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

- (a) Take that portion of the Contract Price properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the total Contract Price allocated to that portion of the Work in the Schedule of Values, less retainage as provided in Section E.5. Pending final determination of cost to the Owner of changes in the Work, no amounts for changes in the Work can be included in applications for payment until the Contract Price has been adjusted by a

Change Order;

- (b) Add that portion of the Contract Price properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner pursuant to Section E.2.3, suitably stored off the site at a location agreed upon in writing), less retainage as provided in Section E.5;
- (c) Subtract the aggregate of previous payments made by the Owner; and
- (d) Subtract any amounts for which the Owner has withheld or nullified payment as provided in the Contract Documents.

E.2.6 Contractor's applications for payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay to a Subcontractor or material supplier.

E.2.7 The Contractor warrants to Owner that title to all Work covered by an application for payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an application for payment all Work for which payments are received from the Owner shall be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided financing, labor, materials and equipment relating to the Work.

E.2.8 If Contractor disputes any determination by Owner with regard to any application for payment, Contractor nevertheless shall continue to expeditiously perform the Work. No payment made hereunder shall be or be construed to be final acceptance or approval of that portion of the Work to which such partial payment relates or shall relieve Contractor of any of its obligations hereunder.

E.2.9 Contractor shall submit its initial MWESB Report within ten (10) Days of Contractor's execution of the Contract. Contractor shall submit annual MWESB Reports on June 30 of each year the Contract is active. Contracts first executed by Contractor within ninety (90) Days before June 30 of the year of execution may at the discretion of Owner be exempt from submitting the annual MWESB Report otherwise due on that June 30. The final MWESB Report shall be filed with the application for final payment. Timely receipt of MWESB Reports by Owner shall be a condition precedent to Owner's obligation to pay any progress payments or final payment otherwise due. Owner shall provide the Contractor with an electronic version of the desired reporting format at the time of execution of the Contract or GMP Amendment for the Contractor's use in submittal of the report, which should be submitted both electronically and in hard copy.

E.3 PAYROLL CERTIFICATION REQUIREMENT

Owner's receipt of payroll certification pursuant to Section C.2 of this Contract shall be a condition precedent to Owner's obligation to pay any progress payments or final payment otherwise due.

E.4 DUAL PAYMENT SOURCES

Contractor shall not be compensated for Work performed under this Contract from any state agency other than the agency that is a party to this Contract.

E.5 RETAINAGE

E.5.1 Retainage shall be withheld and released in accordance with the requirements set forth in former OAR 580-063-0045.

E.5.1.1 Owner may reserve as retainage from any progress payment an amount not to exceed five percent of the payment. As Work
SOU Public Improvement General Conditions (2/9/2016)

progresses, Owner may reduce the amount of retainage on or may eliminate retainage on any remaining monthly Contract payments after 50 percent of the Work under the Contract is completed if, in the Owner's discretion, such Work is progressing satisfactorily. Elimination or reduction of retainage shall be allowed only upon written application by the Contractor, which application shall include written approval of Contractor's surety; except that when the Work is 97-1/2 percent completed the Owner may, at its discretion and without application by the Contractor, reduce the retained amount to 100 percent of the value of the Work remaining to be done. Upon receipt of written application by the Contractor, Owner shall respond in writing within a reasonable time.

E.5.1.2 The Contractor may request in writing:

- (a) to be paid amounts which would otherwise have been retained from progress payments where Contractor has deposited acceptable bonds and securities of equal value with Owner or in a custodial account or other mutually-agreed account with an approved bank or trust company to be held in lieu of the cash retainage for the benefit of Owner;
- (b) for construction projects over \$1,000,000, that retainage be deposited in an interest bearing account, established through the State Treasurer for state agencies, in a bank, savings bank, trust company or savings association for the benefit of Owner, with earnings from such account accruing to the Contractor; or
- (c) that the Owner allow Contractor to deposit a surety bond for the benefit of Owner, in a form acceptable to Owner, in lieu of all or a portion of funds retained, or to be retained. Such bond and any proceeds therefrom shall be made subject to all claims in the manner and priority as set forth for retainage.

When the Owner has accepted the Contractor's election of option (a) or (b), Owner may recover from Contractor any additional costs incurred through such election by reducing Contractor's final payment. Where the Owner has agreed to Contractor's request for option (c), Contractor shall accept like bonds from Subcontractors and suppliers on the project from which Contractor has required retainages.

E.5.1.3 The retainage held by Owner shall be included in and paid to the Contractor as part of the final payment of the Contract Price. The Owner shall pay to Contractor interest at the rate of two-thirds of one percent per month on the final payment due Contractor, interest to commence forty five (45) Days after the date which Owner receives Contractor's final approved application for payment and Work under the Contract has been completed and accepted and to run until the date when final payment is tendered to Contractor. The Contractor shall notify Owner in writing when the Contractor considers the Work complete and deliver to Owner its final application for payment and Owner shall, within thirty (30) Days after receiving the written notice and the application for payment, either accept the Work or notify the Contractor of Work yet to be performed on the Contract. If Owner does not within the time allowed notify the Contractor of Work yet to be performed to fulfill contractual obligations, the interest provided by this subsection shall commence to run forty five (45) Days after the end of the 30- Day period.

E.5.1.4 Owner will reduce the amount of the retainage if the Contractor notifies the Owner that the Contractor has deposited in an escrow account with a bank or trust company, in a manner authorized by the Owner, bonds and securities of equal value of a kind approved by the Owner and such bonds and securities have in fact been deposited in accordance with Applicable Laws.

E.5.1.5 The Contractor agrees that if Contractor elects to reserve a retainage from any progress payment due to any Subcontractor

or supplier, such retainage shall not exceed five percent of the payment, and such retainage withheld from Subcontractors and suppliers shall be subject to the same terms and conditions stated in Subsection E.5 as apply to Owner's retainage from any progress payment due to Contractor.

E.6 FINAL PAYMENT

E.6.1 Upon completion of all the Work under this Contract, the Contractor shall notify the Owner, in writing, that Contractor has completed Contractor's obligations under the Contract and shall prepare its application requesting final payment. Upon receipt of such notice and application for payment, the Owner will inspect the Work, and, if acceptable, submit to Contractor a recommendation as to acceptance of the completed Work and the final estimate of the amount due the Contractor. If the Work is not acceptable, Owner will notify Contractor within fifteen (15) Days of Contractor's request for final payment. Upon approval of this final application for payment by the Owner and compliance by the Contractor with provisions in Section K, and Contractor's satisfaction of other provisions of the Contract Documents as may be applicable, the Owner shall pay to the Contractor all monies due under the provisions of these Contract Documents.

E.6.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Owner (1) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least thirty (30) Days' prior written notice has been given to the Owner, (2) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (3) consent of surety, if any, to final payment and (4), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

E.6.3 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final application for payment.

E.6.4 Contractor agrees to submit its final payment application within ninety (90) Days after Substantial Completion, unless written extension is granted by Owner. Contractor shall not delay final payment application for any reason, including without limitation nonpayment of Subcontractors, suppliers, manufacturers or others not a party to this Contract, or lack of resolution of a dispute with Owner or any other person of matters arising out of or relating to the Contract. If Contractor fails to submit its final payment application within ninety (90) Days after Substantial Completion, and Contractor has not obtained written extension by Owner, all requests or Claims for additional costs or an extension of Contract Time shall be waived.

SECTION F **JOB SITE CONDITIONS**

F.1 USE OF PREMISES

Contractor shall confine equipment, storage of materials and operation of Work to the limits indicated by Contract Documents, Applicable Laws, permits or directions of the Owner. Contractor shall follow the Owner's instructions regarding use of premises, if any.
SOU Public Improvement General Conditions (2/9/2016)

F.2 PROTECTION OF WORKERS, PROPERTY AND THE PUBLIC

The Contractor shall maintain continuous and adequate protection of all of the Work from damage and shall protect the Owner, workers and property from injury or loss arising in connection with this Contract. Contractor shall remedy acceptably to the Owner any damage, injury, or loss, except such as may be directly due to errors in the Contract Documents or caused by authorized representatives or personnel of the Owner. Contractor shall adequately protect adjacent property as provided by law and the Contract Documents.

F.2.1 The Contractor shall take all necessary precautions for the safety of all personnel on the job site or otherwise engaged in the undertaking of the Work and shall comply with the Contract Documents, best practices and all applicable provisions of federal, state and municipal safety laws and building and fire codes to prevent accidents or injury to persons on, about or adjacent to the premises where the Work is being performed. Contractor shall erect and properly maintain at all times, as required by the conditions and progress of the Work, all necessary safeguards for protection of workers and the public against any hazards created by construction. Contractor shall designate a responsible employee or associate on the Work site, whose duty shall be the prevention of accidents. The name and position of the person designated shall be reported to the Owner. The Owner has no responsibility for Work site safety. Work site safety shall be the responsibility of the Contractor.

F.2.2 The Contractor shall not enter upon private property without first obtaining permission from the property owner or its duly authorized representative. Contractor shall be responsible for the preservation of all public and private property along and adjacent to the Work contemplated under the Contract and shall use every precaution necessary to prevent damage thereto. In the event the Contractor damages any property, the Contractor shall at once notify the property owner and make, or arrange to make, full restitution. Contractor shall, immediately and in writing, report to the Owner all pertinent facts relating to such property damage and the ultimate disposition of the claim for damage.

F.2.3 The Contractor shall be responsible for protection of adjacent work areas including impacts brought about by activities, equipment, labor, utilities, vehicles and materials on the site.

F.2.4 The Contractor shall at all times direct its activities in such a manner as to minimize adverse effects on the environment. Handling of all materials shall be conducted so no release will occur that may pollute or become hazardous. Contractor shall verify that all mechanical or electrical equipment in the construction areas that may be affected by the Work is in working order and shall notify the Owner, in writing, of any equipment not in working order prior to the start of the Work. Start of Work will be considered as acknowledgement that all equipment is in good working order. Contractor shall be required to restore equipment to its original, or better, condition upon completion of the project.

F.2.5 In an emergency affecting the safety of life or limb or of the Work or of adjoining property, the Contractor, without special instruction or authorization from the Owner, shall act reasonably to prevent threatened loss or injury, and shall so act, without appeal, if instructed by the Owner. Any compensation claimed by the Contractor on account of emergency work shall be determined in accordance with section D.

F.3 CUTTING AND PATCHING

F.3.1 The Contractor shall be responsible for coordinating all

cutting, fitting, or patching of the Work to make its several parts come together properly and fit to receive or be received by work of other contractors or Subcontractors shown upon, or reasonably implied by, the Contract Documents.

- F.3.2 The Contractor shall be responsible for restoring all cut, fitted, or patched surfaces to an original condition; provided, however, that if a different condition is specified in the Contract Documents, then Contractor shall be responsible for restoring such surfaces to the condition specified in the Contract Documents.

F.4 CLEANING UP

From time to time as may be prudent or ordered by the Owner and, in any event, immediately after completion of the Work, the Contractor shall, at its own expense, clean up and remove all refuse and unused materials of any kind resulting from the Work. If Contractor fails to do so within twenty-four hours after notification by the Owner the work may be done by others and the cost charged to the Contractor and deducted from payment due the Contractor.

F.5 ENVIRONMENTAL CONTAMINATION

- F.5.1. Contractor shall be held responsible for and shall indemnify, defend (with counsel of Owner's choice), and hold harmless Owner from and against any costs, expenses, damages, claims, and causes of action, (including attorney fees), or any of them, resulting from all spills, releases, discharges, leaks and disposal of environmental pollution, including storage, transportation, and handling during the performance of the Work or Contractor's obligations under the Contract which occur as a result of, or are contributed by, the negligence or actions of Contractor or its personnel, agents, or Subcontractors or any failure to perform in accordance with the Contract Documents (except to the extent otherwise void under ORS 30.140). Nothing in this section F.5.1 shall limit Contractor's responsibility for obtaining insurance coverages required under Section G.3 of this Contract, and Contractor shall take no action that would void or impair such coverages.

- F.5.1.1 The Contractor agrees to promptly dispose of such spills, releases, discharge or leaks to the satisfaction of Owner and regulatory agencies having jurisdiction in a manner that complies with Applicable Laws. Cleanup shall be at no cost to the Owner and shall be performed by properly qualified and, if applicable, licensed personnel.

- F.5.1.2 The Contractor shall obtain the Owner's written consent prior to bringing onto the Work site any (i) environmental pollutants or (ii) hazardous substances or materials, as the same or reasonably similar terms are used in any Applicable Laws. Notwithstanding such written consent from the Owner, the Contractor, at all times, shall:

- (a) properly handle, use and dispose of all environmental pollutants and hazardous substances or materials brought onto the Work site, in accordance with all Applicable Laws;
- (b) be responsible for any and all spills, releases, discharges, or leaks of (or from) environmental pollutants or hazardous substances or materials which Contractor has brought onto the Work site; and
- (c) promptly clean up and remediate, without cost to the Owner, such spills, releases, discharges, or leaks to the Owner's satisfaction and in compliance with all Applicable Laws.

- F.5.2 The Contractor shall report all reportable quantity releases, as such releases are defined in Applicable Laws, including but not limited to 40 CFR Part 302, Table 302.4 and in OAR 340-142-0050, to applicable federal, state, and local regulatory and emergency response agencies. Upon discovery, regardless of quantity, Contractor must telephonically report all releases to the

Owner. A written follow-up report shall be submitted to Owner within 48 hours of the telephonic report. Such written report shall contain, as a minimum:

- (a) Description of items released (identity, quantity, manifest numbers, and any and all other documentation required by law.)
- (b) Whether amount of items released is EPA/DEQ reportable, and, if so, when reported.
- (c) Exact time and location of release, including a description of the area involved.
- (d) Containment procedures initiated.
- (e) Summary of communications about the release between Contractor and members of the press or State, local or federal officials other than Owner.
- (f) Description of cleanup procedures employed or to be employed at the site, including disposal location of spill residue.
- (g) Personal injuries, if any, resulting from, or aggravated by, the release.

F.6 ENVIRONMENTAL CLEAN-UP

- F.6.1 Unless disposition of environmental pollution is specifically a part of this Contract, or was caused by the Contractor (reference F.5 Environmental Contamination), Contractor shall immediately notify Owner of any hazardous substance(s) which Contractor discovers or encounters during performance of the Work required by this Contract. "Hazardous substance(s)" means any hazardous, toxic and radioactive materials and those substances defined as "hazardous substances," "hazardous materials," "hazardous wastes," "toxic substances," or other similar designations in any federal, state, or local law, regulation, or ordinance, including without limitation asbestos, polychlorinated biphenyl (PCB), or petroleum, and any substances, materials or wastes regulated by 40 CFR, Part 261 and defined as hazardous in 40 CFR S 261.3. In addition to notifying Owner of any hazardous substance(s) discovered or encountered, Contractor shall immediately cease working in any particular area of the project where a hazardous substance(s) has been discovered or encountered if continued work in such area would present a risk or danger to the health or well-being of Contractor's or any Subcontractor's work force, property or the environment.

- F.6.2 Upon being notified by Contractor of the presence of hazardous substance(s) on the project site, Owner shall arrange for the proper disposition of such hazardous substance(s).

F.7 FORCE MAJEURE

A party to this Contract shall not be held responsible for delay or default due to Force Majeure acts, events or occurrences unless they could have been avoided by the exercise of reasonable care, prudence, foresight, and diligence by that party. The Owner may terminate this Contract upon written notice after determining that delay or default caused by Force Majeure acts, events or occurrences will reasonably prevent successful performance of the Contract.

SECTION G **INDEMNITY, BONDING, AND** **INSURANCE**

G.1 RESPONSIBILITY FOR DAMAGES / INDEMNITY

- G.1.1 The Contractor shall be responsible for all damage to property,

injury to persons, and loss, expense, inconvenience, and delay that may be caused by, or result from, the carrying out of the Work to be done under this Contract, or from any act, omission or neglect of the Contractor, its Subcontractors, employees, guests, visitors, invitees and agents.

To the fullest extent permitted by law, Contractor shall indemnify, defend (with counsel approved by Owner) and hold harmless the Owner, Architect/Engineer, Architect/Engineer's consultants, and their respective officers, directors, agents, employees, partners, members, stockholders and affiliated companies (collectively "Indemnitees") from and against all liabilities, damages, losses, claims, expenses (including reasonable attorney fees), demands and actions of any nature whatsoever which arise out of, result from or are related to, (a) any damage, injury, loss, expense, inconvenience or delay described in this Section G.1., (b) any accident or occurrence which happens or is alleged to have happened in or about the project site or any place where the Work is being performed, or in the vicinity of either, at any time prior to the time the Work is fully completed in all respects, (c) any failure of the Contractor to observe or perform any duty or obligation under the Contract Documents which is to be observed or performed by the Contractor, or any breach of any agreement, representation or warranty of the Contractor contained in the Contract Documents or in any subcontract, (d) the negligent acts or omissions of the Contractor, a Subcontractor or anyone directly or indirectly employed by them or any one of them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder (except to the extent otherwise void under ORS 30.140), and (e) any lien filed upon the project or bond claim in connection with the Work. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Section G.1.2.

G.1.2 In claims against any person or entity indemnified under Section G.1.2 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section G.1.2 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

G.2 PERFORMANCE AND PAYMENT SECURITY; PUBLIC WORKS BOND

G.2.1 When the Contract Price is \$100,000 or more (or \$50,000 or more in the case of Contracts for highways, bridges and other transportation projects), the Contractor shall furnish and maintain in effect at all times during the Contract Period a performance bond in a sum equal to the Contract Price and a separate payment bond also in a sum equal to the Contract Price. Contractor shall furnish such bonds even if the Contract Price is less than the above thresholds if otherwise required by the Contract Documents.

G.2.2 Bond forms furnished by the Owner and notarized by awarded Contractor's surety company authorized to do business in Oregon are the only acceptable forms of performance and payment security, unless otherwise specified in the Contract Documents.

G.2.3 Before execution of the Contract the Contractor shall file with the Construction Contractors Board, and maintain in full force and effect, the separate public works bond required by Oregon Laws 2005, Chapter 360, and OAR 839-025-0015, unless otherwise exempt under those provisions. The Contractor shall also include in every subcontract a provision requiring the Subcontractor to have a public works bond filed with the Construction Contractors Board before starting Work, unless

otherwise exempt, and shall verify that the Subcontractor has filed a public works bond before permitting any Subcontractor to start Work.

G.3 INSURANCE

G.3.1 Primary Coverage: Insurance carried by Contractor under this Contract shall be the primary coverage. The coverages indicated are minimums unless otherwise specified in the Contract Documents.

G.3.2 Workers' Compensation: All employers, including Contractor, that employ subject workers who work under this Contract in the State of Oregon shall comply with ORS 656.017 and provide the required Workers' Compensation coverage, unless such employers are exempt under ORS 656.126. This shall include Employer's Liability Insurance with coverage limits of not less than the minimum amount required by statute for each accident. Contractors who perform the Work without the assistance or labor of any employee need not obtain such coverage if the Contractor certifies so in writing. Contractor shall ensure that each of its Subcontractors complies with these requirements. The Contractor shall require proof of such Workers' Compensation coverage by receiving and keeping on file a certificate of insurance from each Subcontractor or anyone else directly employed by either the Contractor or its Subcontractors.

G.3.3 Builder's Risk Insurance:

G.3.3.1 Builder's Risk: During the term of this Contract, for new construction the Contractor shall obtain and keep in effect Builder's Risk insurance on an all risk forms, including earthquake and flood, for an amount equal to the full amount of the Contract, plus any changes in values due to modifications, Change Orders and loss of materials added. Such Builder's Risk shall include, in addition to earthquake and flood, theft, vandalism, mischief, collapse, transit, debris removal, and architect's fees "soft costs" associated with delay of project due to insured peril. Any deductible shall not exceed \$50,000 for each loss, except the earthquake and flood deductible which shall not exceed 2 percent of each loss or \$50,000, whichever is greater. The deductible shall be paid by Contractor if Contractor is negligent. The policy will include as loss payees Owner, the Contractor and its Subcontractors as their interests may appear.

G.3.3.2 Builder's Risk Installation Floater: For Work other than new construction, Contractor shall obtain and keep in effect during the term of this Contract, a Builder's Risk Installation Floater for coverage of the Contractor's labor, materials and equipment to be used for completion of the Work performed under this Contract. The minimum amount of coverage to be carried shall be equal to the full amount of the Contract. The policy will include as loss payees Owner, the Contractor and its Subcontractors as their interests may appear. Owner may waive this requirement at its sole and absolute discretion.

G.3.3.3 Such insurance shall be maintained until Owner has occupied the facility.

G.3.3.4 A loss insured under the Builder's Risk insurance shall be adjusted by the Owner and made payable to the Owner as loss payee. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner. The Owner shall have power to adjust and settle a loss with insurers.

G.3.4 General Liability Insurance:

G.3.4.1 Commercial General Liability: Upon execution of a Contract, Contractor shall obtain, and keep in effect at Contractor's expense for the term of the Contract, Commercial General

Liability Insurance ("CGL") covering bodily injury and property damage in the amount of not less than \$1,000,000 per claim and \$2,000,000 per occurrence in a form satisfactory to Owner. This insurance shall include personal injury liability, products and completed operations, and contractual liability coverage for the indemnities provided under this Contract (to the extent contractual liability coverage for the indemnity is available in the marketplace), and shall be issued on an occurrence basis written on ISO Form GC 00 01 (12 04 or later) or an equivalent form approved in advance by Owner. The CGL shall provide separation of insured language.

G.3.4.2 Automobile Liability: Contractor shall obtain, at Contractor's expense, and keep in effect during the term of this Contract, Automobile Liability Insurance covering owned, and/or hired vehicles, as applicable. The coverage may be written in combination with the Commercial General Liability Insurance. Contractor shall provide proof of insurance of not less than \$1,000,000 per claim and \$2,000,000 per occurrence. Contractor and its Subcontractors shall be responsible for ensuring that all non-owned vehicles maintain adequate Automobile Liability insurance while on site.

G.3.4.3 Owner may adjust the insurance amounts required in Section G.3.4.1 and G.3.4.2 based upon institution specific risk assessments through the issuance of Supplemental General Conditions and a Contract.

G.3.4.4 To the extent that the Contract Documents require the Contractor to provide professional design services, design-build, or certifications related to systems, materials, or equipment, the Contractor shall (1) purchase and maintain professional liability/errors-and-omissions insurance with limits of not less than \$1,000,000 for each claim and (2) cause those Subcontractors (of any tier) who are providing professional design services including any design-build services to procure and maintain professional liability/errors-and-omissions insurance with limits of not less than \$1,000,000 for each claim.

G.3.4.5 "Tail" Coverage: If any of the required liability insurance is arranged on a "claims made" basis, "tail" coverage will be required at the completion of this Contract for a duration of 36 months or the maximum time period available in the marketplace if less than 36 months. Contractor shall furnish certification of "tail" coverage as described or continuous "claims made" liability coverage for 36 months following Final Completion. Continuous "claims made" coverage will be acceptable in lieu of "tail" coverage, provided its retroactive date is on or before the effective date of this Contract. Owner's receipt of the policy endorsement evidencing such coverage shall be a condition precedent to Owner's obligation to make final payment and to Owner's final acceptance of Work or services and related warranty (if any).

G.3.4.6 Umbrella Liability (if required by Owner through issuance of Supplemental General Conditions): Contractor shall obtain, at Contractor's expense, and keep in effect during the term of the Contract, Umbrella liability Insurance over and above the general liability, automobile liability and workers' compensation coverage if required by Owner in specified limits at time of requirement.

G.3.4.6 Pollution Liability (if required by Owner through issuance of Supplemental General Conditions): Contractor shall obtain, at Contractor's expense, and keep in effect during the term of the Contract, Pollution liability Insurance in minimum amounts of \$3,000,000 naming Owner as "additional insured," as noted in the "additional insured section below.

G.3.5 Additional Insured: The general liability insurance coverage, automobile liability, umbrella, and pollution liability if required, shall include the Owner as additional insureds but only with respect to the Contractor's activities to be performed under this

Contract. The additional-insured endorsement for CGL insurance must be written on ISO Form CG 20 10 (10 01) and CG 20 37 (10 01), or their equivalent, but shall not use either of the following forms: CG 20 10 (10 93) or CG 20 10 (03 94).

G.3.5.1 If Contractor cannot obtain an insurer to name the Owner as additional insureds, Contractor shall obtain at Contractor's expense, and keep in effect during the term of this Contract, Owners and Contractors Protective Liability Insurance, naming the Owner as additional insureds with not less than a \$2,000,000 limit per occurrence. This policy must be kept in effect for 36 months following Final Completion. As evidence of coverage, Contractor shall furnish the actual policy to Owner prior to execution of the Contract.

G3.6 Notice of Cancellation or Change: If the Contractor receives a non-renewal or cancellation notice from an insurance carrier affording coverage required herein, or receives notice that coverage no longer complies with the insurance requirements herein, Contractor agrees to notify Owner by fax within five (5) business days with a copy of the non-renewal or cancellation notice, or written specifics as to which coverage is no longer in compliance. When notified by Owner, the Contractor agrees to stop Work pursuant to this Contract, unless all required insurance remain in effect. Any failure to comply with the reporting provisions of this insurance, except for the potential exhaustion of aggregate limits, shall not affect the coverages provided to the Owner and its institutions, divisions, officers, and employees.

Owner shall have the right, but not the obligation, of prohibiting Contractor from entering the Work site until a new certificate(s) of insurance is provided to Owner evidencing the replacement coverage. The Contractor agrees that Owner reserves the right to withhold payment to Contractor until evidence of reinstated or replacement coverage is provided to Owner.

G.3.7 Certificate(s) of Insurance: As evidence of the insurance coverage required by the Contract, the Contractor shall furnish certificate(s) of insurance to the Owner prior to execution of the Contract. The certificate(s) will specify all of the parties who are additional insureds or loss payees for the contract. Insurance coverage required under this Contract shall be obtained from insurance companies or entities acceptable to the Owner and that are eligible to provide such insurance under Oregon law. Eligible insurers include admitted insurers that have been issued a certificate of authority from the Oregon Department of Consumer and Business Services authorizing them to conduct an insurance business and issue policies of insurance in the state of Oregon, and certain non-admitted surplus lines insurers that satisfy the requirements of applicable Oregon law and which are subject to approval by the Owner. The Contractor shall be financially responsible for all deductibles, self-insured retentions and/or self-insurance included hereunder. Any deductible, self-insured retention and/or self-insurance in excess of \$50,000 shall be subject to approval by the Owner in writing and shall be a condition precedent to the effectiveness of any Contract.

SECTION H SCHEDULE OF WORK

H.1 CONTRACT PERIOD

H.1.1 Time is of the essence. The Contractor shall at all times carry on the Work diligently, without delay and punctually fulfill all requirements herein. If required by the Contract Documents, Contractor shall commence Work on the site within fifteen (15) Days of Notice to Proceed, unless directed otherwise.

H.1.2 Unless specifically extended by Change Order, all Work shall be complete by the date contained in the Contract Documents. The Owner shall have the right to accelerate the completion date of the Work, which may require the use of

overtime. Such accelerated Work schedule shall be an acceleration in performance of Work under Section D.1.2 (f) and shall be subject to the provisions of Section D.1.

- H.1.3 The Owner shall not waive any rights under the Contract by permitting the Contractor to continue or complete in whole or in part the Work after the date described in Section H.1.2 above.

H.2 SCHEDULE

Contractor shall provide, by or before the pre-construction conference, a detailed project Work schedule for review and acceptance by the Owner. The submitted schedule must illustrate Work by significant project components, significant labor trades, long lead items, broken down by building and/or floor where applicable. Each schedule item shall account for no greater than 5% of the monetary value of the project or 5% of the available time. Schedules with activities of less than one day or valued at less than 1% of the Contract shall be considered too detailed and shall not be accepted. Schedules lacking adequate detail, or unreasonably detailed, shall be rejected. Included within the schedule are the following: Notice to Proceed, Substantial Completion, and Final Completion. Contractor shall provide an updated, full project schedule with each payment request. In addition, twice monthly, the Contractor shall provide an updated three-week forward-looking schedule. Acceptance of the Schedule by the Owner does not constitute agreement by the Owner as to the Contractor's sequencing, means, methods, or durations. Any positive difference between the Contractor's scheduled completion and the contract completion date is float owned by the Owner. Use of the float shall be negotiated. In no case shall the Contractor make a claim for delays if the Work is completed within the Contract Period but after Contractor's scheduled completion.

H.3 PARTIAL OCCUPANCY OR USE

- H.3.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage, provided such occupancy or use is consented to by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have reasonably accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, insurance or self-insurance, maintenance, heat, utilities, and damage to the Work, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents with respect to such portion of the Work. Approval by the Contractor to partial occupancy or use shall not be unreasonably withheld. Immediately prior to such partial occupancy or use, the Owner and Contractor shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

SECTION I **CORRECTION OF WORK**

I.1 CORRECTION OF WORK BEFORE FINAL PAYMENT

The Contractor warrants to the Owner that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects, and that the Work will conform to the requirements of the Contract Documents. Work failing to conform to these requirements shall be deemed defective. Contractor shall promptly remove from the premises and replace all defective materials and equipment as determined by the Owner, whether incorporated in the Work or not. Removal and replacement shall be without loss or expense to the Owner, and Contractor shall bear the cost of repairing all Work destroyed or damaged by such removal or replacement. Contractor shall be allowed a period of no longer than thirty (30) Days

after Substantial Completion for completion of defective (Punch List) work. At the end of the thirty-day period, or earlier if requested by the Contractor, Owner shall arrange for inspection of the Work by the Architect/Engineer. Should the work not be complete, and all corrections made, the costs for all subsequent reinspections shall be borne by the Contractor. If Contractor fails to complete the Punch List work within the thirty (30) Day period, Owner may perform such work and Contractor shall reimburse Owner all costs of the same within ten (10) Days after demand without affecting Contractor's obligations.

I.2 WARRANTY WORK

- I.2.1 Neither the final certificate of payment nor any provision of the Contract Documents shall relieve the Contractor from responsibility for defective Work and, unless a longer period is specified, Contractor shall correct all defects that appear in the Work within a period of one year from the date of issuance of the written notice of Substantial Completion by the Owner except for latent defects which will be remedied by the Contractor at any time they become apparent. The Owner shall give Contractor notice of defects with reasonable promptness. Contractor shall perform such warranty work within a reasonable time after Owner's demand. If Contractor fails to complete the warranty work within such period as Owner determines reasonable, or at any time in the event of warranty work consisting of emergency repairs, Owner may perform such work and Contractor shall reimburse Owner all costs of the same within ten (10) Days after demand, without affecting Contractor's obligations. The Contractor shall perform the warranty Work by correcting defects within twenty-four (24) hours of notification by Owner, unless otherwise specified in the Contract Documents. Should the Contractor fail to respond within the specified response time, the Owner may, at its option, complete the necessary repairs using another contractor or its own forces. If Owner completes the repairs using Owner's own forces, Contractor shall pay Owner at the rate of one and one-half (1½) times the standard hourly rate of Owner's forces, plus related overhead and any direct non-salary costs. If Owner completes the repairs using another contractor, Contractor shall pay Owner the amount of Owner's direct costs billed by the other contractor for the work, plus the direct salary costs and related overhead and direct non-salary expenses of Owner's forces who are required to monitor that contractor's work. Work performed by Owner using Owner's own forces or those of another contractor shall not affect the Contractor's contractual duties under these provisions, including warranty provisions.
- I.2.2 Nothing in this Section I.2 shall negate guarantees or warranties for periods longer than one year including, without limitation, such guarantees or warranties required by other sections of the Contract Documents for specific installations, materials, processes, equipment or fixtures.
- I.2.3 In addition to Contractor's warranty, manufacturer's warranties shall pass to the Owner and shall not take effect until such portion of the Work covered by the applicable warranty has been accepted in writing by the Owner.
- I.2.4 The one-year period for correction of Work shall be extended with respect to portions of Work performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work, and shall be extended by corrective Work performed by the Contractor pursuant to this Section, as to the Work corrected. The Contractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.
- I.2.5 Nothing contained in this Section I.2 shall be construed to establish a period of limitation with respect to other obligations which the Contractor might have under the Contract Documents. Establishment of the period for correction of Work as described in this Section I.2 relates only

to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

- J.1.2 If the Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Price will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

SECTION J

SUSPENSION AND/OR TERMINATION OF THE WORK

J.1 OWNER'S RIGHT TO SUSPEND THE WORK

- J.1.1 The Owner has the authority to suspend portions or all of the Work due to the following causes:

- (a) Failure of the Contractor to correct unsafe conditions;
- (b) Failure of the Contractor to carry out any provision of the Contract;
- (c) Failure of the Contractor to carry out orders;
- (d) Conditions, in the opinion of the Owner, which are unsuitable for performing the Work;
- (e) Time required to investigate differing site conditions;
- (f) Any reason considered to be in the public interest.

- J.1.2 The Owner shall notify Contractor and the Contractor's Surety in writing of the effective date and time of the suspension, and Owner shall notify Contractor and Contractor's surety in writing to resume Work.

J.2 CONTRACTOR'S RESPONSIBILITIES

- J.2.1 During the period of the suspension, Contractor is responsible to continue maintenance at the project just as if the Work were in progress. This includes, but is not limited to, protection of completed Work, maintenance of access, protection of stored materials, temporary facilities, and clean-up.
- J.2.2 When the Work is recommenced after the suspension, the Contractor shall replace or renew any Work damaged during the suspension, remove any materials or facilities used as part of temporary maintenance, and complete the Work in every respect as though its prosecution had been continuous and without suspension.

J.3 COMPENSATION FOR SUSPENSION

- J.3.1 Depending on the reason for suspension of the Work, the Contractor or the Owner may be due compensation by the other party. If the suspension was required due to acts or omissions of Contractor, the Owner may assess the Contractor actual costs of the suspension in terms of administration, remedial work by the Owner's forces or another contractor to correct the problem associated with the suspension, rent of temporary facilities, and other actual costs related to the suspension. If the suspension was caused by acts or omissions of the Owner, the Contractor may be due compensation which shall be defined using Section D, Changes in Work. If the suspension was required through no fault of the Contractor or the Owner, neither party shall owe the other for the impact.

J.4 OWNER'S RIGHT TO TERMINATE CONTRACT

- J.4.1 The Owner may, without prejudice to any other right or remedy, and after giving Contractor seven (7) Days' written notice and an opportunity to cure, terminate the Contract in whole or in part under the following conditions:

- (a) If Contractor should, voluntarily or involuntarily, seek protection under the United States Bankruptcy Code and Contractor as debtor-in-possession or the Trustee for the estate fails to assume the Contract within a reasonable time;
- (b) If Contractor should make a general assignment for the benefit of Contractor's creditors;
- (c) If a receiver should be appointed on account of Contractor's insolvency;
- (d) If Contractor should repeatedly refuse or fail to supply an adequate number of skilled workers or proper materials to carry on the Work as required by the Contract Documents, or otherwise fail to perform the Work in a timely manner;
- (e) If Contractor should repeatedly fail to make prompt payment to Subcontractors or for material or labor, or should disregard laws, ordinances or the instructions of the Owner; or
- (f) If Contractor is otherwise in breach of any part of the Contract.
- (g) If Contractor is in violation of Applicable Laws, either in the conduct of its business or in its performance of the Work.

- J.4.2 At any time that any of the above occurs, Owner may exercise all rights and remedies available to Owner at law or in equity, and, in addition, Owner may take possession of the premises and of all materials and appliances and finish the Work by whatever method it may deem expedient. In such case, the Contractor shall not be entitled to receive further payment until the Work is completed. If the Owner's cost of finishing the Work exceeds the unpaid balance of the Contract Price, Contractor shall pay the difference to the Owner.

J.5 TERMINATION FOR CONVENIENCE

- J.5.1 Owner may terminate the Contract in whole or in part whenever Owner determines that termination of the Contract is in the best interest of Owner or the public.
- J.5.2 The Owner shall provide the Contractor with seven (7) Days prior written notice of a termination for Owner's or for public convenience. After such notice, the Contractor shall provide the Owner with immediate and peaceful possession of the premises and materials located on and off the premises for which the Contractor received progress payment under Section E. Compensation for Work terminated by the Owner under this provision will be according to Section E. In no circumstance shall Contractor be entitled to lost profits for Work not performed due to termination.

J.6 ACTION UPON TERMINATION

- J.6.1 Upon receiving a notice of termination, and except as directed otherwise by the Owner, Contractor shall immediately cease placing further subcontracts or orders for materials, services, or facilities. In addition, Contractor shall terminate all subcontracts or orders to the extent they relate to the Work terminated and, with the prior written approval of the Owner, settle all outstanding liabilities and termination settlement proposals arising from the termination of subcontracts and orders.
- J.6.2 As directed by the Owner, Contractor shall, upon termination, transfer title and deliver to the Owner all

Record Documents, information, and other property that, if the Contract had been completed, would have been required to be furnished to the Owner.

- J.6.3 Upon Owner's notice of termination pursuant to either Section J.4 or J.5, if Owner shall so elect, Contractor shall assign to the Owner such subcontracts and orders as Owner shall specify. In the event Owner elects to take assignment of any such subcontract or order, Contractor shall take such action and shall execute such documents as Owner shall reasonably require for the effectiveness of such assignment and Contractor shall ensure that no contractual arrangement between it and its subcontractors or suppliers of any tier or sub-tier shall prevent such assignment.

SECTION K CONTRACT CLOSEOUT

K.1 RECORD DOCUMENT

As a condition of final payment (and subject to the provisions of section E.6), Contractor shall comply with the following: Contractor shall provide Record Documents for the entire project to Owner. Record Documents shall depict the project as constructed and shall reflect each and every change, modification, and deletion made during the construction. Record Documents are part of the Work and shall be provided prior to the Owner's issuance of final payment. Record Documents include all modifications to the Contract Documents, unless otherwise directed, and accurate MWESB Reports.

K.2 OPERATION AND MAINTENANCE MANUALS

As part of the Work, Contractor shall submit two completed operation and maintenance manuals ("O & M Manuals") for review by the Owner prior to submission of any pay request for more than 75% of the Work. Owner's receipt of the O & M Manuals shall be a condition precedent to any payment thereafter due. The O & M Manuals shall contain a complete set of all submittals, all product data as required by the specifications, training information, telephone list and contact information for all consultants, manufacturers, installer and suppliers, manufacturer's printed data, record and shop drawings, schematic diagrams of systems, appropriate equipment indices, warranties and bonds. The Owner shall review and return one O & M Manual for any modifications or adjustments required. Prior to submission of its final pay request, Contractor shall deliver two complete and approved sets of O & M Manuals in paper form and one complete and approved set in electronic form to the Owner and Owner's receipt of the O & M Manuals shall be a condition precedent to Owner's obligation to make final payment.

K.3 COMPLETION NOTICES

- K.3.1 The Contractor shall provide Owner written notice of both Substantial and Final Completion. The certificate of Substantial Completion shall state the date of Substantial Completion, the responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and the time within which the Contractor shall finish all items on the Punch List accompanying the Certificate. Both completion notices must be signed by the Contractor and the Owner to be valid. The Owner shall provide the final signature on the approved notices. The notices shall take effect on the date they are signed by the Owner.

- K.3.2 Substantial Completion of a facility with operating systems (e.g., mechanical, electrical, HVAC) shall be that degree of completion that has provided a minimum of thirty (30) continuous Days of successful, trouble-free operation, which period shall begin after all performance and acceptance testing has been successfully demonstrated to the Owner. All equipment contained in the Work, plus all other components necessary to enable the Owner to operate the facility in the manner that was intended, shall be complete on the Substantial Completion date. The Contractor may request that a Punch List be prepared by the Owner with submission of the request for the Substantial

Completion notice.

K.4 TRAINING

As part of the Work, and prior to submission of the final application for payment, the Contractor shall schedule with the Owner training sessions for all equipment and systems as required by the Contract Documents. Contractor shall schedule training sessions at least two weeks in advance of the date of training to allow Owner to provide its personnel with adequate notice. The O & M Manual shall be used as a basis for training. Training shall be a formal session conducted at the Work site, or as required by the Contract Documents, after the equipment and/or system is completely installed and operational in its normal operating environment. One additional "refresher" training at no cost to owner will be required upon owner request for up to 1 year after initial training for equipment or system to be conducted on site. Free web and phone consulting to be provided for one year.

K.5 EXTRA MATERIALS

As part of the Work, Contractor shall provide spare parts, extra maintenance materials, and other materials or products in the quantities specified in the Contract Documents prior to final payment. Delivery point for extra materials shall be designated by the Owner.

K.6 ENVIRONMENTAL CLEAN-UP

As part of the Final Completion notice, or as a separate written notice submitted with or before the notice of Final Completion, the Contractor shall notify the Owner that all environmental and pollution clean-up, remediation and closure have been completed in accordance with all Applicable Laws and pursuant to the authority of all agencies having jurisdiction, and Contractor shall provide Owner with any and all documentation related to the same, including but not limited to directives, orders, letters, certificates and permits related to or arising from such environmental pollution. The notice shall reaffirm the indemnification given under Section F.5.1 above. Contractor's completion of its obligations under this Section K.6 and Owner's receipt of documents evidencing such completion shall be a condition precedent to Owner's obligation to make final payment.

K.7 CERTIFICATE OF OCCUPANCY

Owner's receipt of an unconditioned certificate of occupancy from the appropriate state and/or local building officials shall be a condition precedent to Owner's obligation to make final payment, except to the extent failure to obtain an unconditional certificate of occupancy is due to the fault or neglect of Owner.

K.8 OTHER CONTRACTOR RESPONSIBILITIES

The Contractor shall be responsible for returning to the Owner all property of Owner issued to Contractor during construction such as keys, security passes, site admittance badges, and all other pertinent items. Upon notice from Owner, Contractor shall be responsible for notifying the appropriate utility companies to transfer utility charges from the Contractor to the Owner. The utility transfer date shall not be before Substantial Completion and may not be until Final Completion, if the Owner does not take beneficial use of the facility and the Contractor's forces continue with the Work.

K.9 SURVIVAL

All warranty and indemnification provisions of this Contract, and all of Contractor's other obligations under this Contract that are not fully performed by the time of Final Completion or termination, shall survive Final Completion or any termination of the Contract.

SOUTHERN OREGON UNIVERSITY
STANDARD PUBLIC IMPROVEMENT CONTRACT
PERFORMANCE BOND

Bond No. _____
Solicitation _____
Project Name _____

_____ (Surety #1)	Bond Amount No. 1:	\$ _____
_____ (Surety #2)*	Bond Amount No. 2:*	\$ _____
	Total Penal Sum of Bond:	\$ _____

** If using multiple sureties*

We, _____ as Principal, and the above identified Surety(ies), authorized to transact surety business in Oregon, as Surety, hereby jointly and severally bind ourselves, our respective heirs, executors, administrators, successors and assigns firmly by these presents to pay unto Southern Oregon University (SOU), the sum of (Total Penal Sum of Bond) _____ (Provided, that we the Sureties bind ourselves in such sum “jointly and severally” as well as “severally” only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposes each Surety binds itself, jointly and severally with the Principal, for the payment of such sum only as is set forth opposite the name of such Surety), and

WHEREAS, the Principal has entered into a contract with SOU, the plans, specifications, terms and conditions of which are contained in the above-referenced Solicitation;

WHEREAS, the terms and conditions of the contract, together with applicable plans, standard specifications, special provisions, schedule of performance, and schedule of contract prices, are made a part of this Performance Bond by reference, whether or not attached to the contract (all hereafter called “Contract”); and

WHEREAS, the Principal has agreed to perform the Contract in accordance with the terms, conditions, requirements, plans and specifications, and all authorized modifications of the Contract which increase the amount of the work, the amount of the Contract, or constitute an authorized extension of the time for performance, notice of any such modifications hereby being waived by the Surety:

NOW, THEREFORE, THE CONDITION OF THIS BOND IS SUCH that if the Principal herein shall faithfully and truly observe and comply with the terms, conditions and provisions of the Contract, in all respects, and shall well and truly and fully do and perform all matters and things undertaken by Contractor to be performed under the Contract, upon the terms set forth therein, and within the time prescribed therein, or as extended as provided in the Contract, with or

without notice to the Sureties, and shall indemnify and save harmless SOU, and members thereof, its officers, employees and agents, against any direct or indirect damages or claim of every kind and description that shall be suffered or claimed to be suffered in connection with or arising out of the performance of the Contract by the Principal or its subcontractors, and shall in all respects perform said contract according to law, then this obligation is to be void; otherwise, it shall remain in full force and effect.

Nonpayment of the bond premium will not invalidate this bond, nor shall SOU, be obligated for the payment of any premiums.

This bond is given and received under authority of ORS Chapters 279C and 351, the provisions of which hereby are incorporated into this bond and made a part hereof.

IN WITNESS WHEREOF, WE HAVE CAUSED THIS INSTRUMENT TO BE EXECUTED AND SEALED BY OUR DULY AUTHORIZED LEGAL REPRESENTATIVES.

Dated this _____ day of _____, 20__.

PRINCIPAL: _____

By _____

Signature

Official Capacity

Attest: _____

Corporation Secretary

SURETY: _____

[Add signatures for each surety if using multiple bonds]

BY ATTORNEY-IN-FACT:

[Power-of-Attorney must accompany each surety bond]

Name

Signature

Address

City

State

Zip

Phone

Fax

SOUTHERN OREGON UNIVERSITY

STANDARD PUBLIC IMPROVEMENT CONTRACT

PAYMENT BOND

Bond No. _____

Solicitation _____

Project Name _____

_____ (Surety #1)	Bond Amount No. 1:	\$ _____
_____ (Surety #2)*	Bond Amount No. 2:*	\$ _____
<i>* If using multiple sureties</i>	Total Penal Sum of Bond:	\$ _____

We, _____, as Principal, and the above identified Surety(ies), authorized to transact surety business in Oregon, as Surety, hereby jointly and severally bind ourselves, our respective heirs, executors, administrators, successors and assigns firmly by these presents to pay unto Southern Oregon University (SOU), the sum of (Total Penal Sum of Bond) _____ (Provided, that we the Sureties bind ourselves in such sum “jointly and severally” as well as “severally” only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposes each Surety binds itself, jointly and severally with the Principal, for the payment of such sum only as is set forth opposite the name of such Surety), and

WHEREAS, the Principal has entered into a contract with the SOU, the plans, specifications, terms and conditions of which are contained in above-referenced Solicitation;

WHEREAS, the terms and conditions of the contract, together with applicable plans, standard specifications, special provisions, schedule of performance, and schedule of contract prices, are made a part of this Payment Bond by reference, whether or not attached to the contract (all hereafter called “Contract”); and

WHEREAS, the Principal has agreed to perform the Contract in accordance with the terms, conditions, requirements, plans and specifications, and schedule of contract prices which are set forth in the Contract and any attachments, and all authorized modifications of the Contract which increase the amount of the work, or the cost of the Contract, or constitute authorized extensions of time for performance of the Contract, notice of any such modifications hereby being waived by the Surety:

NOW, THEREFORE, THE CONDITION OF THIS BOND IS SUCH that if the Principal shall faithfully and truly observe and comply with the terms, conditions and provisions of the Contract, in all respects, and shall well and truly and fully do and perform all matters and things by it undertaken to be performed under said Contract and any duly authorized modifications that are made, upon the terms set forth therein, and within the time prescribed therein, or as extended therein as provided in the Contract, with or without notice to the Sureties, and shall indemnify and save harmless SOU and its officers, employees and agents, against any claim for direct or indirect damages of every kind and description that shall be suffered or claimed to be suffered in connection with or arising out of the performance of the Contract by the Contractor or its

subcontractors, and shall promptly pay all persons supplying labor, materials or both to the Principal or its subcontractors for prosecution of the work provided in the Contract; and shall promptly pay all contributions due the State Industrial Accident Fund and the State Unemployment Compensation Fund from the Principal or its subcontractors in connection with the performance of the Contract; and shall pay over to the Oregon Department of Revenue all sums required to be deducted and retained from the wages of employees of the Principal and its subcontractors pursuant to ORS 316.167, and shall permit no lien nor claim to be filed or prosecuted against SOU on account of any labor or materials furnished; and shall do all things required of the Principal by the laws of this State, then this obligation shall be void; otherwise, it shall remain in full force and effect.

Nonpayment of the bond premium will not invalidate this bond, nor shall SOU be obligated for the payment of any premiums.

This bond is given and received under authority of ORS Chapters 279C and 351, the provisions of which hereby are incorporated into this bond and made a part hereof.

IN WITNESS WHEREOF, WE HAVE CAUSED THIS INSTRUMENT TO BE EXECUTED AND SEALED BY OUR DULY AUTHORIZED LEGAL REPRESENTATIVES:

Dated this _____ day of _____, 20__.

PRINCIPAL: _____

By _____
Signature

Official Capacity

Attest: _____
Corporation Secretary

SURETY: _____

[Add signatures for each if using multiple bonds]

BY ATTORNEY-IN-FACT:

[Power-of-Attorney must accompany each bond]

Name

Signature

Address

City State Zip

Phone Fax

PART 1 GENERAL**1.1 REQUIREMENTS INCLUDED**

- A. Contract Description
- B. Conditions of the Contract
- C. Contract Type
- D. Work Sequence
- E. Owner Occupancy
- F. Contractors Use of Premises
- G. Future Work
- H. Specification Conventions

1.2 CONTRACT DESCRIPTION

- A. The work scope includes a complete buildout at the 2nd floor of SOU Central Hall. The area of work is approximately 12,828 square feet. Work includes, but is not limited to, the following:
 - 1. Non-structural wood partitions
 - 2. Thermal & acoustical insulation.
 - 3. Doors, HM frames, hardware
 - 4. Glazing and translucent resin panels
 - 5. Casework and architectural wood trim
 - 6. Complete interior finishes (floors, walls, ceilings)
 - 7. Architectural specialties
 - 8. Fire suppression (extension of existing sprinkler system)
 - 9. Plumbing
 - 10. HVAC (terminal units, ducting, hydronics, mini split, controls)
 - 11. Electrical (branch panels & wiring, lighting, lighting controls, fire alarm, data, access controls, PV solar)
 - 12. Miscellaneous related work.

1.3 CONDITIONS OF THE CONTRACT

- A. The Conditions of the Contract and the General Requirements (Division 1) of these Specifications apply to the work described under each Section hereof. The Contractor shall instruct each subcontractor to incorporate those provisions in their bids.

1.4 CONTRACT TYPE

- A. Construct the Work under a single lump sum contract. A sample contract is included in section B-6 of this project manual.

1.5 WORK SEQUENCE

- A. Sequence and schedule Work to permit Owner's continuous use of the building during construction.
- B. The Contractor shall take all measures necessary to maintain building security and weather protection during the entire project
- C. The Contractor will take all measures necessary to secure the work zone(s) around the building, and to provide safe passage for SOU staff, students and visitors.

1.6 OWNER OCCUPANCY

- A. SOU will occupy the building throughout the entire project.

1.7 CONTRACTOR USE OF PREMISES

- A. Contractor shall limit use of premises to allow:
 - 1. Owner occupancy of adjacent facilities
 - 2. Work by other contractors
 - 3. Work by Owner
- B. Coordinate work on or adjacent to the building with SOU's ongoing operations.
- C. Assume full responsibility for protection and safekeeping of building components and equipment scheduled to remain after execution of this contract.
- D. Utility interruptions must be scheduled with SOU a minimum of 48 hours in advance.

1.8 OWNER-FURNISHED PRODUCTS INSTALLED BY OWNER (OFOI)

- A. A/V equipment
- B. IT equipment
- C. Window treatments
- D. Furniture

1.9 OWNER-FURNISHED PRODUCTS INSTALLED BY CONTRACTOR (OFCI)

- A. EV charging stations
- B. Toilet Accessories (TP Holder, Paper Towel Disp., Toilet Seat Cover Disp., Sanitary Napkin Receptacles).
- C. Restroom Signage

END OF SECTION

SECTION 012000
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Schedule of values.
- B. Applications for payment.
- C. Change procedures.
- D. Defect assessment.
- F. Alternates.

1.2 SCHEDULE OF VALUES

- A. Submit printed schedule on AIA Form G703 - Continuation Sheet for G702. Contractor's standard form or electronic media printout will be considered.
- B. Submit Schedule of Values within 15 days after date of Owner-Contractor Agreement.
- C. Format: Utilize Table of Contents of this Project Manual. Identify each line item with number and title of major specification Section. Identify site mobilization, bonds and insurance and supervision.
- D. Include separately from within each line item, direct proportional amount of Contractor's overhead and profit.
- E. Add approved change orders to the bottom of the Schedule of Values on each Application for Payment.

1.3 APPLICATIONS FOR PAYMENT

- A. Submit a PDF copy of each application on AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702.
- B. Content and Format: Use Schedule of Values for listing items in Application for Payment.
- C. Submit updated construction schedule with each Application for Payment.
- D. Payment Period: Submit Payment Application each month during construction of the Project. Submit with transmittal letter as specified for Submittals in Section 013300.
- E. Payment: Payments are to be made per Section B-8 of the General Conditions.
- F. Substantiating Data: With each Payment Application submit:
 - 1. Copies of invoices from each entity performing work or providing materials for the time period.
 - 2. Description of materials stored off-site. Proof of insurance covering one-hundred percent replacement cost of off-site stored materials.
- G. Payment for products stored off the project site: When delay or added cost to Owner can be avoided by storing Products off Site Owner will make payment to Contractor for such Products provided Contractor shall:
 - 1. Locate Storage Facilities within 20 mile of Project Site or within 50 miles of Architect's Office.
 - 2. Make Storage Facilities available for Architect's observation.
 - 3. Segregate and label Stored Products for specified Project.
 - 4. Assume all risk for loss.
 - 5. Assume responsibility for exceeding Product "shelf life."
 - 6. Protect Stored Products and provide applicable Insurance against their damage, discoloration, and theft, listing the Owner and any Mortgagee as Additional Named Insureds.

7. Submit itemized Inventory and Schedule of Values for Stored Products together with Certificate of Insurance.

1.4 CHANGE PROCEDURES

- A. Submittals: Submit name of individual authorized to receive change documents and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. The Architect will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing an Instruction Bulletin.
- C. Request for Information (RFI): Requests for information, clarifications, interpretations and changes which may or may not change the contract sum shall be made on a form acceptable to the Owner, Architect and Contractor.
- D. The Architect may issue a Request for Information (RFI) including a detailed description of proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change and the period of time during which the requested price will be considered valid. Contractor will prepare and submit estimate within three days.
- E. Contractor may propose changes by submitting a Request for Information (RFI) to Architect, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors. Document requested substitutions in accordance with Section 016000.
- F. Stipulated Sum/Price Change Order: Based on Proposal Request and Contractor's fixed price quotation or Contractor's request for Change Order as approved by Architect.
- G. Construction Change Directive: Architect may issue directive, on AIA Form G713 Construction Change Directive signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.
- H. Change Order Forms: AIA G701 Change Order.
- I. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in Conditions of the Contract.
- J. Correlation of Contractor Submittals:
 1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
 2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
 3. Promptly enter changes in Project Record Documents.

1.5 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. If, in the opinion of the Architect, it is not practical to remove and replace the Work, the Architect will direct appropriate remedy or adjust payment.
- C. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction
- D. Authority of Architect to assess defects and identify payment adjustments, is final.

- E. Non-Payment for Rejected Products: Payment will not be made for rejected products for any of the following:
1. Products wasted or disposed of in a manner that is not acceptable.
 2. Products determined as unacceptable before or after placement.
 3. Products not completely unloaded from transporting vehicle.
 4. Products placed beyond lines and levels of required Work.
 5. Products remaining on hand after completion of the Work.
 6. Loading, hauling, and disposing of rejected products.

1.6 ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work.
- C. Schedule of Alternates: As listed in Section 012300 Alternates.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

**SECTION 012300
ALTERNATES**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Documentation of changes to Contract Sum.
- B. Contract Documents contain pertinent requirements for materials and methods to accomplish work described herein.
- C. Provide alternate costs for inclusion in Contract Sum if accepted by Owner.

1.2 RELATED REQUIREMENTS

- A. Owner/Contractor Agreement: Alternates accepted by Owner for incorporation into the Work.
- B. Individual specification sections identified.

1.3 PROCEDURES

- A. Alternates will be exercised at the option of Owner.
- B. Coordinate related work and modify surrounding work as required to complete the work, including changes under each Alternate, when acceptance is designated in Owner/Contractor Agreement.

1.4 DESCRIPTION OF ALTERNATES

- A. Alternate No. 1 – Add Grid-Tied Rooftop Solar Photovoltaic System.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION

SECTION 012500

SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Product Substitution Procedures.

1.2 GENERAL

- A. Definition: Proposal by Contractor to use manufacturer, product, material, or system different from one required in Contract Documents.
- B. Do not substitute Products unless a substitution request has been approved by Architect.
- C. Substitutions requests will ONLY be considered due to non-availability of a specified Product through no fault of Contractor. Architect will consider substitution requests within 30 days after award of Contract. After initial 30 day period, no substitutions will be allowed.
- D. In case of non-availability of a specified Product notify Architect in writing as soon as non-availability becomes apparent.

1.3 SUBSTITUTION REQUESTS

- A. Submit substitution requests on form provided by Architect.
- B. Document specified product and proposed substitution with complete data, including:
 - 1. Product identification, including name and address of manufacturer.
 - 2. Product description, performance and test data, and reference standards.
 - 3. Sample, if requested.
 - 4. Description of any anticipated effect that acceptance of proposed substitution will have on Progress Schedule, construction methods, or other items of Work.
 - 5. Description of any differences between specified product and proposed substitution.
 - 6. Difference in cost between specified product and proposed substitution.
- C. Burden of proof for substantiating compliance of proposed substitution with Contract Document requirements remains with Contractor.
- D. A request constitutes a representation that the Contractor:
 - 1. Has investigated the proposed Product and determined that it meets or exceeds the quality level of the specified Product.
 - 2. Will provide the same warranty for the substitution as for the specified Product.
 - 3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
 - 5. Will reimburse Owner for design services associated with re-approval by authorities or revisions to Contract Documents to accommodate the substitution.
- E. Substitutions will not be considered if:
 - 1. They are indicated or implied on Shop Drawings or other submittals without submittal of a substitution request.
 - 2. Approval will require substantial revision of Contract Documents without additional compensation to Architect.
- F. Submit 3 hard copies or submit electronically in Adobe PDF format.

G. Architect will notify Contractor of approval or rejection of each Substitution Request.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION

SUBSTITUTION REQUEST FORM

DATE: _____

TO: _____

ATTENTION: _____

PROJECT: _____

We submit for your consideration the following product as a substitution for the specified product:

Section No.	Paragraph	Specified Product

_____	_____	_____

Proposed Substitution: _____

Reason for Substitution: _____

Product Data:

Attach complete technical data for both the specified product and the proposed substitution. Include information on changes to Contract Documents that the proposed substitution will require for its proper installation.

Samples:

___ Attached ___ Will be furnished upon request

Does the substitution affect dimensions shown on Drawings?

___ No ___ Yes (explain) _____

Effects of proposed substitution on other Work:

Differences between proposed substitution and specified Product:

Manufacturer's warranties of the proposed substitution are:

☐ Same ☐ Different (explain) _____

Maintenance service and spare parts are available for proposed substitution from:

Previous installations where proposed substitution may be seen:

Project: _____	Project: _____
Owner: _____	Owner: _____
Architect: _____	Architect: _____
Date Installed: _____	Date Installed: _____

Cost savings to be realized by Owner, if proposed substitution is approved:

Change to Contract Time, if proposed substitution is approved:

☐ No Change ☐ Add _____ days ☐ Deduct _____ days

Submittal constitutes a representation that Contractor has read and agrees to the provisions of Section 01 2500.

Submitted by Contractor:

Signature

Firm

For Use by Architect:

Based on the information supplied by the Contractor, the Architect has reviewed the proposed substitution on the basis of design concept of the Work and conformance with information given in Contract Documents.

☐ Approved ☐ Approved as Noted ☐ Rejected

Submit Additional Information: _____

By: _____ Date: _____

SECTION 012613
REQUESTS FOR INFORMATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Requests for Information (RFI's).
- B. Related Sections:
 - 1. Section 016000 – Product Requirements (Product Substitution Procedures).
 - 2. Section 013300 - Submittal Procedures.
 - 3. Section 017000 - Closeout Procedures.

1.2 GENERAL

- A. Request for Information (RFI): Request from Contractor seeking interpretation or clarification of Contract Documents not involving Substitutions or changes to Contract Sum or Contract Time.
- B. RFI's constitute a request for information only.
- C. Do not submit RFI's:
 - 1. To request approval of substitutions; refer to Section 012500.
 - 2. To request approval of submittals; refer to Section 013300.
 - 3. To submit Project Record Documents; refer to Section 017000.

1.3 SUBMITTAL

- A. Submit RFI's on form approved by Architect.
- B. Include on each RFI:
 - 1. Name of Contractor.
 - 2. Project name.
 - 3. Date submitted.
 - 4. Sequential RFI number.
 - 5. Applicable Drawing sheet and detail numbers or Specification Section numbers.
 - 6. Date when response information is required to avoid impact on Construction Schedule and Construction Cost.
- C. Review and sign RFI's submitted by Subcontractors, Sub-Subcontractors, or Suppliers prior to submittal to Architect.
- D. Maintain log of RFI's showing RFI number and current status of each RFI.
- E. When RFI's require submittal of drawings, follow submittal procedures specified for Shop Drawings in Section 013300.
- F. Submit electronically in PDF format.
- G. Allow minimum 5 working days for Architect's review and response to each RFI.

END OF SECTION

SECTION 013000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coordination and project conditions.
- B. Preconstruction meeting.
- C. Site mobilization meeting.
- D. Progress meetings.
- E. Pre-installation meetings.
- F. Cutting and patching.
- G. Special procedures.

1.2 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.
- C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.
- E. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's occupancy.
- F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.3 PRECONSTRUCTION MEETING

- A. Architect will schedule meeting after Notice of Award.
- B. Attendance Required: Owner, Architect and Contractor. Subcontractors are encouraged to attend.
- C. Agenda:
 - 1. Execution of Owner-Contractor Agreement.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Distribution of Contract Documents.
 - 4. Submission of list of Subcontractors, list of products, schedule of values, and progress schedule.
 - 5. Designation of personnel representing parties in Contract.
 - 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 - 7. Submission of monthly estimated construction costs cash flow over duration of project.
 - 8. Scheduling and work sequencing.

- 9. Miscellaneous administrative issues.
- D. Architect will provide a conference report and distribute copies within two days after meeting to Owner and Contractor. Owner and Contractor will copy others as they require.

1.4 SITE MOBILIZATION MEETING

- A. Contractor shall schedule meeting at Project site prior to Contractor occupancy.
- B. Attendance Required: Owner, Architect, Special Consultants, Contractor, Contractor's Superintendent, and major Subcontractors.
- C. Agenda:
 - 1. Use of premises by Owner and Contractor.
 - 2. Owner's requirements and occupancy.
 - 3. Construction facilities and controls provided by Owner.
 - 4. Temporary utilities provided by Owner.
 - 5. Survey and building layout.
 - 6. Security and housekeeping procedures.
 - 7. Schedules.
 - 8. Application for payment procedures.
 - 9. Procedures for testing.
 - 10. Procedures for maintaining record documents.
 - 11. Requirements for start-up of equipment.
 - 12. Inspection and acceptance of equipment put into service during construction period.
- D. Contractor will provide a conference report two days after meeting to participants, with copies to Architect, Owner and major Subcontractors. Owner and Architect will copy others as they require.

1.5 PROGRESS MEETINGS

- A. Contractor shall schedule and administer meetings throughout progress of the Work at weekly intervals, dates and location as confirmed by Contractor, Architect and Owner.
- B. Architect will prepare agenda and preside at progress meetings.
- C. Attendance Required: Job superintendent, major subcontractors and suppliers when impacted by the current or impending work, Owner, Architect, and Consulting Engineers as appropriate to agenda topics for each meeting.
- D. General Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of past week's work progress.
 - 3. Review Construction Schedule. Identify items adversely affecting schedule and corrective measures needed to maintain Schedule.
 - 4. Review proposed work for week following meeting
 - 5. Review field observations, problems, and decisions.
 - 6. Review of submittals schedule and status of submittals.
 - 7. Review of off-site fabrication and delivery schedules.
 - 8. Changes: Change Orders, R.F.I.'s
- E. Contractor will provide a conference report and distribute copies after meeting to the Architect and Owner. Owner and Architect will distribute copies to others as they require.

1.6 PRE-INSTALLATION MEETINGS

- A. When required in individual specification sections, Contractor shall convene pre-installation meetings at Project site prior to commencing work of specific section.
- B. Require attendance of parties directly affecting, or affected by, Work of specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of installation, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 CUTTING AND PATCHING

- A. Employ skilled and experienced installer to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements affecting:
 - 1. Structural integrity of element.
 - 2. Integrity of weather-exposed or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate contractor.
- C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
 - 1. Fit the several parts together, to integrate with other Work.
 - 2. Uncover Work to install or correct ill-timed Work.
 - 3. Remove and replace defective and non-conforming Work.
 - 4. Remove samples of installed Work for testing.
 - 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute Work by methods to avoid damage to other Work, and to provide proper surfaces to receive patching and finishing.
- E. Cut masonry and concrete materials using masonry saw or core drill.
- F. Restore Work with new products in accordance with requirements of Contract Documents.
- G. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material to full thickness of penetrated element.
- J. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
- K. Identify hazardous substances or conditions exposed during the Work to Architect for decision or remedy.

3.2 SPECIAL PROCEDURES

- A. Materials: As specified in product sections; match existing with new products and salvaged products for patching and extending work.
- B. Employ original, skilled and experienced installer to perform alteration work.
- C. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.

- D. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
- E. Remove debris and abandoned items from area and from concealed spaces. Prepare surface and remove surface finishes to permit installation of new work and finishes.
- F. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.
- G. Remove, cut, and patch Work in manner to minimize damage and to permit restoring products and finishes to original or specified condition.
- H. Refinish existing visible surfaces to remain in renovated rooms and spaces, to renewed condition for each material, with neat transition to adjacent finishes.
- I. Where new Work abuts or aligns with existing, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- J. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Architect for review.
- K. Where change of plane of 1/4 inch or more occurs, submit recommendation for providing smooth transition; to Architect for review.
- L. Trim existing doors to clear new floor finish. Refinish trim to original condition.
- M. Provide all new fasteners and required installation accessories required to install salvaged items.
- N. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.
- O. Finish surfaces as specified in individual product sections.

END OF SECTION

SECTION 013300
SUMMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittal procedures.
- B. Proposed products list.
- C. Product data.
- D. Shop drawings.
- E. Samples.
- F. Test reports.
- G. Certificates.
- H. Manufacturer's instructions.
- I. Erection drawings.

1.2 SUBMITTAL PROCEDURES

- A. Transmit each submittal with transmittal form.
- B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
- C. On transmittal form Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.
- D. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents, prior to submission to Architect for approval.
- E. Schedule submittals to expedite Project and deliver to Architect at business address. Coordinate submission of related items.
- F. For each submittal for review, allow seven days excluding delivery time to and from Contractor.
- G. If deviations from the Contract Documents are shown on the submittal, accompany the submittal with a letter on the Contractor's letterhead identifying the specifics of the deviation(s). Explain why acceptance of the deviations by the Architect are of benefit to the Owner's interests.
- H. Allow space on submittals for Contractor and Architect review stamps.
- I. When revised for resubmission, identify changes made since previous submission.
- J. Distribute copies of reviewed submittals as appropriate to completion of the Work. Instruct parties to promptly report inability to comply with requirements. Submittals not requested will not be recognized or processed.
- K. Electronic (PDF format) Submittals are required.

1.3 PROPOSED PRODUCTS LIST

- A. Within 20 days after date of Owner-Contractor Agreement, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.4 PRODUCT DATA

- A. Product Data: Submit to Architect for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Submit PDF copies.
- C. Identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- E. After review, produce PDF copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents described in Section 017000.

1.5 SHOP DRAWINGS

- A. Shop Drawings: Submit to Architect for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Submit PDF copies.
- D. After review, produce PDF copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents described in Section 017000.

1.6 SAMPLES

- A. Samples: Submit to Architect for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Samples for Selection as Specified in Product Sections:
 - 1. Submit to Architect for aesthetic, color, or finish selection.
 - 2. Submit samples of finishes from full range of manufacturers' standard colors, textures, and patterns for Architect selection. Submit samples in custom colors, textures and patterns when requested.
- C. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- D. Include identification on each sample, with full Project information.
- E. Submit number of samples specified in individual specification sections; Architect will retain two samples.
- F. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01700.

1.7 TEST REPORTS

- A. Submit for Architect's knowledge as contract administrator or for Owner.
- B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.8 CERTIFICATES

- A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Architect, in PDF format specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product but must be acceptable to Architect.

1.9 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Architect for delivery to Owner in PDF format for Product Data.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.10 ERECTION DRAWINGS

- A. Submit drawings for Architect's benefit as contract administrator or for Owner.
- B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 013546
INDOOR AIR QUALITY MANAGEMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Indoor Air Quality Management Plan.
 - 2. During construction:
 - a. Protection of heating, ventilating, and air conditioning systems.
 - b. Reducing emissions through source control.
 - c. Pathway interruption.
 - d. Housekeeping.
 - e. Scheduling.

3.2 REFERENCES

- A. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- B. Sheet Metal and Air Conditioning Manufacturer's Association International (SMACNA) - IAQ Guidelines for Occupied Buildings Under Construction.

3.3 SUBMITTALS

- A. Indoor Air Quality Management Plan:
 - 1. Submit Indoor Air Quality Management Plan (IAQ) for review within 14 days after date of Notice to Proceed. Include:
 - a. Procedures for implementing requirements of SMACNA IAQ Guideline.
 - b. Substitution procedures for products that are responsibility of Contractor and proposed source control implementation measures to minimize building contamination.
 - c. Construction sequencing and storage plans for protection of stored on-site or installed absorptive materials against moisture absorption and contamination.
 - d. Product Data for filters including MERV ratings and filter media change schedule. At a minimum filtration must be a MERV 13, or greater, and installed to process outside air that is delivered as supply air.
 - e. Product Date for temporary filtration media at each return air grille verifying a MERV of 8 and narrative describing the change out procedure.
 - f. Name and phone number of Contractor's personnel responsible for instructing workers and overseeing and documenting results of Indoor Air Quality Management Plan.
 - 2. Submit one copy.
 - 3. If required, revise and resubmit plan within ten days after receipt of comments.
 - 4. Distribute copies of approved Indoor Air Quality Management Plan to concerned parties.
- B. Photographs: Document indoor air quality management measures with date-stamped photographs including protection of ducts, on-site storage, and protection of installed absorptive materials and moisture protection methods.
- C. Indoor Air Quality Testing Report showing results of air quality testing.

3.4 QUALITY ASSURANCE

- A. Review and discuss Indoor Air Quality Management Plan implementation and progress at Preconstruction Conference and Progress Meetings.

3.5 DELIVERY, STORAGE AND HANDLING

- A. Designate specific storage areas to facilitate protection of stored absorptive materials.
- B. Clearly identify storage area. Keep clean and orderly; prevent contamination of materials.
- C. Monitor storage areas for contamination; correct problems and implement preventative measures.

3.6 TRAINING

- A. Provide training of indoor air quality management methods to be used at appropriate stages of Project.
- B. Require participation of all subcontractors.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 IMPLEMENTATION - DURING CONSTRUCTION

- A. Meet or exceed SMACNA minimum requirements for heating, ventilating, and air conditioning system protection, source control, pathway interruption, housekeeping, and scheduling.
- B. Protect stored on-site or installed absorptive materials from moisture damage and volatile organic compound contamination through construction sequencing and proper storage.
- C. If air handlers are used during construction, use filtration media with Minimum Efficiency Reporting Value (MERV) of 8 per ASHRAE 52.2.
- D. Replace filtration media just prior to occupancy.
- E. Heating, Ventilating, and Air Conditioning System Protection:
 - 1. Keep duct systems including supply air, return air, and exhaust air and associated equipment including air handlers, variable air volume boxes, silencers, fans, and filter boxes, clean and uncontaminated.
 - 2. Seal taps and open ends not actively being worked on with plastic and tape.
 - 3. Provide 1 inch polyester filter media over return and exhaust air inlets during construction and until Substantial Completion.
 - 4. Ensure that temporary and permanent filters are in place and openings are closed before running fans.
 - 5. Protect existing heating, ventilating, and air conditioning systems with 1 inch polyester media installed over outside air intakes. Change out filter media on intakes to minimize pressure drops. Provide frequent filter change out to keep filter pressure drop at existing fan-coils below approximately 0.30 inch s.p.
- F. Source Control:
 - 1. For temporary and ancillary materials used in construction, follow requirements of similar products to minimize indoor air quality impacts.
 - 2. Use nontoxic formulations and implement other control measures to minimize building contamination.
- G. Pathway Interruption: Isolate areas where work is being performed to prevent contamination of clean spaces.
- H. Housekeeping:
 - 1. Implement cleaning activities concentrating on heating, ventilating, and air conditioning systems and building space to remove contaminants prior to occupancy.
 - 2. Protect materials from weather and store in clean area prior to unpacking.
 - 3. Clean coils, air filters, and fans before performing testing and balancing.
 - 4. Provide temporary walkoff mats at entry points to construction areas; replace or clean daily.

- I. Scheduling:
 - 1. Sequence construction activities to reduce absorption of and volatile organic compounds by materials.
 - 2. Complete applications of wet and odorous materials before installing absorptive materials.

3.2 IMPLEMENTATION - BEFORE OCCUPANCY

- A. Replace filtration media after final cleaning.
- B. Complete air testing and balancing prior to beginning baseline air testing.

END OF SECTION

SECTION 014000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality control and control of installation.
- B. Tolerances
- C. References.
- D. Mock-up requirements.
- E. Testing and inspection services.
- F. Examination.
- G. Preparation.

1.2 QUALITY CONTROL AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. When manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce required and specified quality.
- F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. When specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- E. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.5 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in this section and identified in respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be comparison standard for remaining Work.
- D. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Architect.

1.6 TESTING AND INSPECTION SERVICES

- A. Owner will employ and pay for specified services of an independent firm to perform testing and inspection, to include tests and inspections described in Specification sections and Special Inspections and Testing required by building department.
- B. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by Architect or Owner.
- C. Reports will be submitted by independent firm to Architect, Owner and Contractor, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- D. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify Architect and independent firm 24 hours prior to expected time for operations requiring services.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- E. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- F. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by Architect. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum.
- H. Agency Responsibilities:
 - 1. Test samples of mixes submitted by Contractor.
 - 2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 3. Perform specified sampling and testing of products in accordance with specified standards.
 - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 5. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
 - 6. Perform additional tests required by Architect/Engineer.
 - 7. Attend preconstruction meetings and progress meetings if required
- I. Agency Reports: After each test, promptly submit a PDF copy of report to Architect and to Contractor. When requested by Architect, provide interpretation of test results. Include the following:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Name of inspector.
 - 4. Date and time of sampling or inspection.

5. Identification of product and specifications section.
 6. Location in Project.
 7. Type of inspection or test.
 8. Date of test.
 9. Results of tests.
 10. Conformance with Contract Documents.
- J. Limits on Testing Authority:
1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency or laboratory may not approve or accept any portion of the Work.
 3. Agency or laboratory may not assume duties of Contractor.
 4. Agency or laboratory has no authority to stop the Work.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

END OF SECTION

SECTION 015000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary Utilities:
 - 1. Temporary electricity.
 - 2. Temporary lighting for demolition purposes.
 - 3. Temporary heating.
 - 4. Temporary ventilation.
 - 5. Temporary water service.
 - 6. Temporary sanitary facilities.
- B. Construction Facilities:
 - 1. Field offices.
 - 2. Vehicular access.
 - 3. Parking.
 - 4. Progress cleaning and waste removal.
- C. Temporary Controls:
 - 1. Barriers.
 - 2. Security.
 - 3. Water control.
 - 4. Dust control.
 - 5. Erosion and sediment control.
 - 6. Noise control.
 - 7. Smoking area.
- D. Removal of utilities, facilities, and controls.

1.2 TEMPORARY ELECTRICITY

- A. Contractor may use existing on-site power.
- B. SOU will pay for electricity consumption during construction. Contractor is required to conserve energy.
- C. Contractor is responsible for all temporary wiring and distribution during construction.

1.3 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain lighting of sufficient luminescence for construction operations.
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps for specified lighting levels.
- C. Provide breakage-protective devices around lighting fixtures.
- D. Permanent building lighting may be utilized during construction. Contractor to thoroughly clean all fixtures prior to substantial completion or Owner occupancy.

1.4 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- B. Provide temporary fan units as required to maintain clean air for construction operations.
- C. Provide ventilation as required to prevent odors from construction operations from migrating into occupied parts of the building.

1.5 TELEPHONE SERVICE

- A. Provide cell phone numbers for project manager & superintendent.

1.6 TEMPORARY WATER SERVICE

- A. Contractor is permitted to use existing building water service. Extend branch piping with outlets located so water is available by hoses with threaded connections.

1.7 TEMPORARY SANITARY FACILITIES

- A. Provide chemical toilets for use during construction.
- B. Existing restroom facilities may not be used during construction.
- C. Maintain facilities in clean and sanitary condition.

1.8 FIELD OFFICES

- A. Field Office and subcontractor trailers may be located in the designated staging area West of the building.
- B. Storage Areas and Sheds: As necessary, provide storage sheds sized to store products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products to requirements of Section 016000.
- C. Maintenance and Cleaning:
 - 1. Weekly janitorial services for offices; periodic cleaning and maintenance for office and storage areas.
 - 2. Maintain approach walks free of mud, water, and snow.
- D. Removal: At completion of Work remove buildings, foundations, utility services, and debris. Restore areas to their pre-construction condition.

1.9 VEHICULAR ACCESS

- A. Use existing access routes.
- B. Provide unimpeded access for emergency vehicles. Maintain 20 feet wide driveways with turning space between and around combustible materials.
- C. Provide and maintain access to fire hydrants and control valves free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Use designated existing on-site roads for construction traffic.
- F. Clean daily paved surfaces of Public Rights-of-way soiled by operations of the Work.

1.10 PARKING

- A. Do not allow heavy vehicles or construction equipment in non-designated parking areas.
- B. Maintenance:
 - 1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
 - 2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.
- C. Removal, Repair:
 - 1. Remove temporary materials and construction when permanent paving is usable, before Substantial Completion.
 - 2. Remove underground work and compacted materials to depth of 2 feet; fill and grade site as specified.
 - 3. Repair permanent facilities damaged by use, to specified condition.

- D. See attached map for contractor staging and parking locations.
- E. SOU will not provide parking for contractor vehicles outside of the designated staging area. Contractors may purchase parking permits to park in other SOU parking lots. Parking on public streets adjacent to the campus is available on a first come, first served basis. SOU parking information and virtual permits are available at <https://inside.sou.edu/parking/>

1.11 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.
- B. Broom and vacuum clean interior areas at completion of construction to provide a clean site for next phase of work.
- C. Collect and remove waste materials, debris, and rubbish from site weekly and dispose off-site.
- D. Comply with Section 017419 (Construction Waste Management) requirements.

1.12 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas and adjacent properties. Provide barriers to protect from damage to construction, materials and adjacent properties.
- B. A 6'-0" high chain-link fence with lockable gates surrounding the entire construction area is required.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage. A 6'-0" chain link fence is required around all stored materials and equipment at the staging area.

1.13 SECURITY

- A. Security Program: Protect Work and Owner's operations from theft, vandalism, and unauthorized entry. Maintain program throughout construction period until Owner occupancy.

1.14 DUST CONTROL

- A. Execute Work by methods to minimize raising dust from construction operations.
- B. Provide positive means to prevent air-borne dust from dispersing into atmosphere.
- C. Comply with all applicable Oregon Department of Environmental Quality (DEQ) and Oregon Occupational Safety and Health Administration (OR-OSHA) regulations.

1.15 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise produced by construction operations.
- B. Comply with the City of Ashland noise ordinance and all applicable Oregon DEQ and OR-OSHA regulations.

1.16 SMOKING AREA

- A. Conform to Southern Oregon University's campus no-smoking policy.

1.17 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.
- B. Clean and repair damage caused by installation or use of temporary work.

- C. Restore existing and permanent facilities used during construction to original condition.
Restore permanent facilities used during construction to “like-new” condition.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION NOT USED

END OF SECTION



SECTION 016000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.
- E. Product substitution procedures.

1.2 PRODUCTS

- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- C. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products in accordance with manufacturers' instructions.
- B. Store with seals and labels intact and legible.
- C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- D. For exterior storage of fabricated products, place on sloped supports above ground.
- E. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications.

- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.6 PRODUCT SUBSTITUTION PROCEDURES

- A. Proposals for product substitutions will be accepted by the Architect for review a minimum of 7 days prior to bid deadline.
- B. Beyond the period for acceptance, proposals for product substitution may be considered if a specified product becomes unavailable through no fault of Contractor, or if a proposed product provides significant advantages for the Project or significant cost saving for the Owner.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents; or show how proposed substitution either enhances the Work or is a cost savings to the Owner without compromise to the Work.
- D. A substitution request constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse Owner and Architect for review or redesign services associated with re-approval by authorities having jurisdiction.
- E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- F. Direct response to requester will be given only during period prior to Bid and only by facsimile or by use of requester-provided stamped envelope.
- G. Substitution Request Form: Proposals for substitution must use the form on following page.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SUBSTITUTION REQUEST FORM FOLLOWS

SUBSTITUTION REQUEST FORM

DATE: _____

TO: KSW Architects, Architects

ATTENTION: Matt Small

PROJECT: SOU – Central Hall – Seismic Upgrade & Renovation

We submit for your consideration the following product as a substitution for the specified product:

Section No.	Paragraph	Specified Product

Proposed Substitution: _____

Reason for Substitution: _____

Product Data:

Attach complete technical data for both the specified product and the proposed substitution. Include information on changes to Contract Documents that the proposed substitution will require for its proper installation.

Samples:

___ Attached ___ Will be furnished upon request ___

Does the substitution affect dimensions shown on Drawings?

___ No ___ Yes (explain) _____

Effects of proposed substitution on other Work:

Differences between proposed substitution and specified Product:

Manufacturer's warranties of the proposed substitution are:

☐ Same ☐ Different (explain) _____

Maintenance service and spare parts are available for proposed substitution from:

Previous installations where proposed substitution may be seen:

Project: _____	Project: _____
Owner: _____	Owner: _____
Architect: _____	Architect: _____
Date Installed: _____	Date Installed: _____

Change to Contract Price, if proposed substitution is approved:

☐ No Change ☐ Add _____ ☐ Deduct _____

Change to Contract Time, if proposed substitution is approved:

☐ No Change ☐ Add _____ days ☐ Deduct _____ days

Submittal constitutes a representation that Contractor has read and agrees to the provisions of Section 01 2500.

Submitted by Contractor:

Signature

Firm

For Use by Architect:

Based on the information supplied by the Contractor, the Architect has reviewed the proposed substitution on the basis of design concept of the Work and conformance with information given in Contract Documents.

☐ Approved ☐ Approved as Noted ☐ Rejected

Submit Additional Information: _____

By: _____ Date: _____

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Closeout procedures.
- B. Final cleaning.
- C. Starting of systems.
- D. Demonstration and instructions.
- E. Protecting installed construction.
- F. Project record documents.
- G. Operation and maintenance data.
- H. Spare parts and maintenance products.
- I. Product warranties and product bonds.

1.2 CLOSEOUT PROCEDURES

- A. When the Work is complete submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect review.
- B. Provide to Architect submittals required by the Project Manual and by authorities having jurisdiction of the Work.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- D. Owner will occupy portions of building as specified in Section 011100.
- E. Completion of all requirements of this Section is a prerequisite to the Owner's issuing final payment.

1.3 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. 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.
- C. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.
- D. Replace filters of equipment operated during construction.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.4 STARTING OF SYSTEMS

- A. Two weeks prior to start-up of any mechanical equipment and systems, create a list of all such items scheduled for start-up and present to Owner and Architect. Show anticipated date of start-up for each item.
- B. Notify Architect and Owner seven days prior to start-up of each item of equipment and system.
- C. Verify that each piece of equipment or system has been inspected for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable manufacturer's representative and Contractors' personnel in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report in accordance with Section 01330 that equipment or system has been properly installed and is functioning correctly.

1.5 DEMONSTRATION AND INSTRUCTIONS

- A. Schedule with the Owner periods of demonstration and instruction convenient to Owner's staff and Contractor and subcontractors. At each period of instruction and demonstration obtain names, titles and signatures of attendees.
- B. Demonstrate operation of equipment and controls and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance, and seasonal adjustments required.
- D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.
- E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.6 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

1.7 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, Product Data, and Samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure that entries showing revisions to the original Documents are complete and

- accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
 - D. Record information concurrent with construction progress, not less than weekly.
 - E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
 - F. Record Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish main floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4. Field changes of dimension and detail.
 - 5. Details not on original Contract drawings.
 - G. Submit documents (one full sized set of printed as-built drawings plus PDF files on jump drive) to Architect with claim for final Application for Payment.

1.8 OPERATION AND MAINTENANCE MANUAL

- A. Provide a combined O&M Manual organized by CSI Section
- B. Submit O&M data in pdf format.
- C. Contents: Prepare Table of Contents for each CSI section, with each product or system description identified:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of the Contractor, subcontractors, and equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts lists for each component.
 - d. Drawings and wiring diagrams for equipment and systems
 - e. Operating instructions.
 - f. Maintenance instructions for equipment and systems.
 - g. Troubleshooting & testing procedures
 - h. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - i. Refer to individual specification sections for additional O&M requirements.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Copy of the final, approved submittals.
 - b. Copies of approved shop drawings and product data.
 - c. Air and water balance reports.
 - d. Test reports. Manufacturer's equipment start-up reports.
 - e. Product certificates.
 - f. Photocopies of warranties and bonds.

1.9 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Furnish spare parts, maintenance, and extra products in quantities specified in individual specification sections.
- B. Deliver to and place in location as directed by Owner; obtain receipt of materials by Owner prior to final payment.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 024119
SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolishing designated utilities.
 - 2. Demolishing designated building equipment and fixtures.
 - 3. Demolishing designated construction.
 - 4. Cutting and alterations for completion of the Work.
 - 5. Removing designated items for reuse and Owner's retention.
 - 6. Protecting items designated to remain.
 - 7. Removing demolished materials.
- B. Related Sections:
 - 1. Section 011000 – Summary of Work: Scope of work, sequencing.
 - 2. Section 015000: Temporary facilities and controls.

1.2 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution Requirements: Requirements for submittals.
- B. Project Record Documents: Accurately record actual locations of capped utilities, subsurface obstructions.

1.3 QUALITY ASSURANCE

- A. Conform to applicable codes for demolition work, dust control, products requiring electrical disconnection and re-connection.
- B. Conform to applicable codes for procedures when hazardous or contaminated materials are discovered.
- C. Obtain required permits from authorities having jurisdiction.
- D. Comply with requirements of the insurance carriers providing coverage for this work.

1.4 PRE-DEMOLITION MEETING

- A. Section 013000 - Administrative Requirements: Pre-demolition meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.5 SEQUENCING

- A. Section 011000 - Summary: Requirements for sequencing.

1.6 SCHEDULING

- A. Section 013000 - Administrative Requirements: Requirements for scheduling.
- B. Schedule Work to coincide with new construction.
- C. Coordinate the schedule of noisy, malodorous, dusty demolition with Owners Representative before starting work.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 PREPARATION

- A. Notify affected utility companies before starting work and comply with their requirements.
- B. Mark location and termination of utilities.
- C. Erect, and maintain temporary barriers and security devices, including warning signs and lights, and similar measures, for protection of the public, Owner, and existing improvements indicated to remain.
- D. Erect and maintain weatherproof closures for exterior openings.
- E. Erect and maintain temporary partitions to prevent spread of dust, odors, and noise to permit continued Owner occupancy.
- F. Prevent movement of structure; provide temporary bracing and shoring required to ensure safety of existing structure.
- G. Provide appropriate temporary signage including signage for exit or building egress.
- H. Do not close or obstruct building egress path.
- I. Protect existing construction and equipment indicated to remain.
- J. Protect existing landscape materials, trees and structures indicated to remain.
- K. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

3.2 SALVAGE REQUIREMENTS

- A. Coordinate with Architect to identify building components and equipment required to be removed and delivered to Owner.
- B. Tag components and equipment designated for salvage.
- C. Protect designated salvage items from demolition operations until items can be removed.
- D. Carefully remove building components and equipment indicated to be salvaged.
- E. Disassemble as required to permit removal from building.
- F. Package small and loose parts to avoid loss.
- G. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.
- H. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.
- I. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

3.3 DEMOLITION

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Cease operations immediately when structure appears to be in danger and notify Architect.
- C. Disconnect remove, cap, and identify designated utilities within demolition areas.
- D. Demolish in orderly and careful manner. Protect existing improvements, supporting structural members and equipment.
- E. Carefully remove building components indicated to be reused.
 - 1. Disassemble components as required to permit removal.
 - 2. Package small and loose parts to avoid loss.
 - 3. Mark components and packaged parts to permit reinstallation.
 - 4. Store components, protected from construction operations, until reinstalled.

- F. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.
- G. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.
- H. Dust Control: Use all means necessary to prevent spread of dust during performance this Work.
- I. Remove temporary Work.

3.4

SCHEDULE

- A. Removal of existing functioning mechanical and electrical work shall be accomplished by those trades.
- B. Remove the following equipment and materials for Owner's retention.
 - 1. As indicated in the Drawings and Specifications.
- C. Protect the following materials and equipment remaining:
 - 1. As indicated in the Demolition drawings for Architectural, Mechanical, and Electrical.
- D. Demolish the following materials and equipment:
 - 1. As indicated in the Demolition drawings for Architectural, Mechanical and Electrical.

END OF SECTION

**SECTION 055000
METAL FABRICATIONS**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Handrails.
 - 2. Miscellaneous steel fabrication items.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. American Architectural Manufacturers Association (AAMA):
 - 1. 611 - Voluntary Specification for Anodized Architectural Aluminum.
 - 2. 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Architectural Extrusions and Panels.
 - 3. 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Architectural Extrusions and Panels.
 - 4. 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Architectural Extrusions and Panels.
- B. American Welding Society (AWS):
 - 1. D1.1/D1.1M - Structural Welding Code - Steel.
 - 2. D1.2/D1.2M - Structural Welding Code - Aluminum.
 - 3. D1.6/D1.6M - Structural Welding Code - Stainless Steel.
- C. ASTM International (ASTM):
 - 1. A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
 - 3. A48/A48M - Standard Specification for Gray Iron Castings.
 - 4. A108 - Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
 - 5. A123/A123M - Standard Specification for Zinc (Hot-Galvanized) Coatings on Iron and Steel Products.
 - 6. A283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars.
 - 7. A307 - Standard Specification for Carbon Steel Externally Threaded Standard Fasteners.
 - 8. A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
 - 9. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 10. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - 11. A510 - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Galvanized Steel.
 - 12. A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 13. A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - 14. A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

15. A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy and High-Strength Low-Alloy with Improved Formability.
16. B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
17. B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
18. B241 - Standard Specification for Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
19. E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
- D. National Association of Architectural Metal Manufacturers (NAAMM):
 1. AMP 503 - Finishes for Stainless Steel.
 2. MBG 531 - Metal Bar Grating Manual.
- E. Society for Protective Coatings (SSPC) - Painting Manual.

1.3 SUBMITTALS

- A. Submittals for Review:
 1. Shop Drawings: Show dimensions, metal thicknesses, finishes, joints, attachments, and relationship of work to adjacent construction.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Minimum 5 years documented experience in work of this Section.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store steel above ground on platforms, skids, or other supports; separate with wooden separators.
- B. Protect steel from corrosion.
- C. Prevent damage to prime coat and galvanized coatings.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

- A. Shapes: ASTM A36/A36M.
- B. Plate: ASTM A283.
- C. Sheet: ASTM A1008/A1008M.
- D. Pipe: ASTM A501.
- E. Tube: ASTM A500.
- F. Bars: ASTM A108.

2.2 ACCESSORIES

- A. Exposed Screws: Same material as metal being fastened; Phillips flat head, countersunk, unless noted otherwise.
- B. Bolts: ASTM A307, hexagonal head type.
- C. Primer Paint: SSPC Paint 15, Type 1, red oxide.
- D. Anchoring Cement: Non-shrink cementitious type.

2.3 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. 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.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of component except where specifically noted otherwise.

- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- F. Conceal fastenings where possible.
- G. Welding to conform to AWS D1.1/D1.1M:
 - 1. Use welds for permanent connections where possible. Grind exposed welds smooth.
 - 2. Tack welds prohibited on exposed surfaces.
- H. Powder coat completed items where noted on the Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install items in accordance with approved Shop Drawings.
- B. Install components plumb, level, and rigid.
- C. Welding: AWS D1.1/D1.1M. Grind and fill exposed welds; finish smooth and flush.
- D. Install sleeved components with anchoring cement.
- E. Prevent contact of exterior aluminum and dissimilar metals by use of zinc rich paint, bituminous coating, or non-absorptive gaskets.

3.2 ADJUSTING

- A. Clean and touch up damaged primer paint with same product as applied in shop.

3.3 SCHEDULE

- A. This Schedule includes principal items only; refer to Drawings for additional items not listed.
- B. Handrails: 1 1/2" nominal diameter, Schedule 40 pipe steel.

END OF SECTION

SECTION 06 06 60

Translucent Resin Panel System

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the Plastic Fabrication as shown and specified in the described system(s):
 - 1. Relights
- B. Related Sections include the following:
 - 1. Section 08 11 13 - Hollow Metal Frames

1.3 SUBMITTALS

- A. General: Submit the following in accordance with conditions of contract and Division 1 specification section 01 33 00 "Submittal Procedures".
- B. Product Data: Submit manufacturer's product data; include product description, fabrication information, and compliance with specified performance requirements.
- C. Building Approvals: Plastic Fabrications are to have been evaluated and must be registered with and comply to requirements of the following jurisdictions:
 - 1. Los Angeles Department of Building and Safety (Product must have a LARR [Los Angeles Research Report] number) for use as Light-transmitting Panels
 - 2. ICC-ES Report for Light Transmitting Plastics and Interior Finishes
- D. Samples for Verification:
 - 1. Submit minimum 8-inch by 8-inch sample for each type, texture, pattern and color of solid plastic fabrication.
- E. Maintenance Data: Submit manufacturer's care and maintenance data, including care, repair and cleaning instructions. Include in Project closeout documents.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications
 - 1. Materials and systems shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least five (5) consecutive years and which can show evidence of those materials being satisfactorily used on at least six (6) projects of similar size,

scope and location. At least three (3) of the projects shall have been successful for use five (5) years or longer.

2. Manufactured panels must be produced from a minimum of 40% pre-consumer recycle content. This recycle content must be certified by a recognized 3rd party certification group, such as Scientific Certification Systems (SCS).
3. Completely PVC – Free product
4. Manufacturer must offer a documented reclaim process that will take back, at the manufacturers cost, panels that are at their end-of life cycle. Return process is preceded by following requirements highlighted in Section 02 42 00 Removal and Salvage of Construction Materials.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver Plastic Fabrications, systems and specified items in manufacturer's standard protective packaging.
- B. Do not deliver Plastic Fabrications, system, components and accessories to Project site until areas are ready for installation.
- C. Store materials in a flat orientation in a dry place that is not exposed to exterior elements.
- D. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent damage or staining following installation for duration of project.
- E. Before installing Plastic Fabrications, permit them to reach room temperature.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install Solid Polymer Fabrications until spaces are enclosed and weatherproof, and ambient temperatures and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 WARRANTY

- A. Manufacturer's Special Warranty on Plastic Fabrications: Manufacturer's standard form agreeing to repair or replace units that fail in material or workmanship within the specified warranty period.
- B. Warranty Period: 1 year after the date of substantial completion.
- C. The warranty shall not deprive the owner of other rights or remedies the Owner may have under other provisions of the Contract Documents, and is in addition to and runs concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Manufacturer: 3form, LLC., Salt Lake City, Utah, USA / telephone 801-649-2500

2.2 MATERIALS

- A. Varia Ecoresin™ Sheet / Pattern: Trail Fade

1. Engineered co-polyester resin produced in the USA
2. Sheet Size: Maximum 4' x 10'
3. Thickness: Minimum 1/16"
4. Basis of Design Product: The design of Plastic Fabrications is based on Varia Ecoresin™ as provided by 3form, LLC. Products from other manufacturers must be approved by the Architect or Designer prior to bidding in accordance with the Instructions to Bidders and Section 10 60 00 "Product Requirements".

- B. Interlayer Materials: Compatible with polyesters and bonding process to create a monolithic sheet of material when complete.

- C. Sheet minimum performance attributes:

1. Rate of Burning (ASTM D 635). Material must attain CC1 Rating for a nominal thickness of 1.5 mm (0.060 in.) and greater.
2. Self-Ignition Temperature (ASTM D 1929). Material must have a Self-ignition temperature greater than 650°F.
3. Density of Smoke (ASTM D 2843). Material must have a smoke density less than 75%.
4. Flame spread and Smoke developed testing (ASTM E 84). Material must be able to meet a level of Class A (Flame spread less than 25 and smoke less than 450) at thickness of 1/8", 3/16" and 1".
5. Room Corner Burn Test (NFPA 286). Material must meet Class A criteria at 1/4" (walls only) and 3/8" (walls only/standoffs only) thickness as described by the 2012 *International Building Code*.
6. Extent of Burning (UL 94). Must submit UL card.
7. Impact strength. Minimum impact strength test as measured by ASTM D 3763 of 20 ft. lbs. (for durability, shipping, installation, and use).
8. Safety Glazing. Material must attain a Class A impact rating in accordance with ANSI Z97.1-2004 at 1/8" thickness.
9. UPITT Test for Combustion Product Toxicity: Product must be recorded as "not more toxic than wood".
10. NFPA 269/ASTM 1678 test for toxicity: Product must have a best predicted LC₅₀ value ≤ 80.8 g/m³ Product must have a best predicted corrected for post-flashover conditions LC₅₀ value ≤ 19.0 g/m³
11. Dynamic environmental testing (ASTM standards D 5116 or D 6670). Panels must not have detectable VOC off-gassing agents and must be have Greenguard™ Indoor Air Quality Children and Schools certified.
12. Panels must be produced from a minimum of 40% pre-consumer recycle content. This recycle content must be certified by a recognized 3rd party certification group, such as Scientific Certification Systems (SCS).
13. Building Approvals: Plastic Fabrications are to have been evaluated and must be registered with and comply to requirements of the following jurisdictions:

- a. New York Department of Buildings (Product must have an MEA [Materials and Equipment Acceptance] number) for use as Interior Finishes
- b. Los Angeles Department of Building and Safety (Product must have a LARR [Los Angeles Research Report] number) for use as Light-transmitting Panels
- c. ICC-ES Report for Interior Finishes and Light Transmitting plastics

2.3 FABRICATION

- A. General: Fabricate Plastic Fabrications to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes, profiles and other characteristics are indicated on the drawings.
- B. Comply with manufacturer's written recommendations for fabrication.
- C. Machining: Acceptable means of machining are listed below. Ensure that material is not chipped or warped by machining operations.
 - 1. Sawing: Select equipment and blades suitable for type of cut required.
 - 2. Drilling: Drills specifically designed for use with plastic products.
 - 3. Milling: Climb cut where possible.
 - 4. Routing
 - 5. Tapping
- D. Forming: Form products to shapes indicated using the appropriate method listed below. Comply with manufacturer's written instructions.
 - 1. Cold Bending
 - 2. Hot Bending
 - 3. Thermoforming: Acceptable only on uncoated material.
 - 4. Drape Forming
 - 5. Matched Mold Forming
 - 6. Mechanical Forming
- E. Laminating: Laminate to substrates indicated using adhesives and techniques recommended by manufacturer.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide products of material, size, and shape required for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaner: Type recommended by manufacturer.
- C. Fasteners: Use screws designed specifically for plastics. Self-threading screws are acceptable for permanent installations. Provide threaded metal inserts for applications requiring frequent disassembly such as light fixtures.
- D. Bonding Cements: May be achieved with solvents or adhesives, suitable for use with product and application.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where installation of Plastic Fabrications will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for installation and comply with requirements specified.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions for the installation of Plastic Fabrications.
- B. Manufacturer's shop to fabricate items to the greatest degree possible.
- C. Utilize fasteners, adhesives and bonding agents recommended by manufacturer for type of installation indicated. Material that is chipped, warped, hazed or discolored as a result of installation or fabrication methods will be rejected.
- D. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
- E. Form field joints using manufacturer's recommended procedures. Locate seams in panels so that they are not directly in line with seams in substrates.
- F. We recommend that installation is completed by a 3form Certified Installer. Contact 3form for more information or to get a quote.

3.3 CLEANING AND PROTECTION

- A. Protect surfaces from damage until date of substantial completion. Repair work or replace damaged work, which cannot be repaired to Architect's satisfaction.

END OF SECTION

**SECTION 061000
ROUGH CARPENTRY**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood framing with dimensional lumber.
 - 2. Wood blocking and furring.
 - 3. Wall and roof sheathing.
 - 4. Light gage metal connectors.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 018113 – Sustainable Design Requirements.

1.2 REFERENCES

- A. American Wood Protection Association (AWPA):
 - 1. M4 - Standard for the Care of Preservative Treated Wood Products.
 - 2. U1 - Use Category System - User Specification for Treated Wood.
- B. ASTM International (ASTM):
 - 1. A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 2. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
- C. Engineered Wood Association (APA) PRP-108 - Performance Standards and Qualification Policy for Structural-Use Panels.
- D. West Coast Lumber Inspection Bureau (WCLIB) - Standard Grading Rules for West Coast Lumber.
- E. Western Wood Products Association (WWPA) G-5 - Western Lumber Grading Rules.

1.3 SUBMITTALS

- A. Material Certificates:
 - 1. For load bearing dimensional lumber specified to comply with minimum allowable stresses. Indicate species and grade selected for each use.

1.4 QUALITY ASSURANCE

- A. Lumber Grading Agency: WCLIB DOC PS 20.
- B. Identify lumber and sheet products by official grade mark.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store materials minimum 6 inches above ground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation.
- B. Do not store seasoned or treated materials in damp location.
- C. Protect edges and corners of sheet materials from damage.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Lumber:
 - 1. Species: Douglas Fir Coast Region.
 - 2. Grading rules: WCLIB Standard Grading and Dressing Rule No. 17, as amended to date.
 - 3. Surfacing: Surfaced four sides (S4S), unless otherwise indicated.
 - 4. Maximum moisture content: 19 percent.

- 5. Grade:
 - a. Non-load bearing partition wall studs, plates and blocking: No.2.
- B. Sheet Products:
 - 1. Panel grade: APA Rated Sheathing or US Product Standard PS-95.
 - 2. Type: CDX Plywood or Oriented Strand Board.
 - 3. Exposure:
 - a. Exterior applications: Exterior.
 - b. Interior applications: Exposure 1.
 - 4. Span rating and nominal thickness:
 - a. Roof sheathing: 32/16, 5/8 inch nominal.
 - b. Wall sheathing: 24/0, 1/2 inch nominal.
 - c. Confirm thickness with structural drawings, structural drawings override this specification.

2.2 ACCESSORIES

- A. Light gage metal connectors:
 - 1. Basis of design: Simpson Strong Tie.
 - 2. Equivalent products by following manufacturers are acceptable:
 - a. KC Metals Products, Inc.
 - b. USP Structural Connectors.
 - 3. Finish: Hot-dip galvanized steel, ASTM A653/A653M, G90 coating class.
- B. Fasteners:
 - 1. Type and size: As required by conditions of use.
 - 2. Finish: Hot-dip galvanized steel, ASTM A153/A153M, G90 coating class.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Provide blocking, nailers, grounds, furring, and other similar items required to receive and support work.
- B. Set members level, plumb, and rigid.
- C. Treat field cuts and holes in members providing structural support in accordance with AWWA M4.

END OF SECTION

**SECTION 062000
FINISH CARPENTRY**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes finish carpentry items: wood acoustic walls, wood trim; hardware and attachment accessories.
- B. Related Sections:
 - 1. Section 099000 - Paints and Coatings: Painting and finishing of finish carpentry.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A135.4 - Basic Hardboard.
- B. APA-The Engineered Wood Association:
 - 1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.
- C. American Society for Testing and Materials:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. Architectural Woodwork Institute:
 - 1. AWI - Quality Standards Illustrated.
- E. Hardwood Plywood and Veneer Association:
 - 1. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.
- F. National Institute of Standards and Technology:
 - 1. NIST PS 20 - American Softwood Lumber Standard.
- G. Woodwork Institute of California:
 - 1. WIC - Manual of Millwork.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Samples:
 - 1. Submit two 12 inch samples of each item specified, illustrating wood grain and specified finish.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with WIC (Woodwork Institute of California) Manual of Millwork, Premium Grade.

1.5 QUALIFICATIONS

- A. Fabricator: Must have a minimum of 5 years experience in the fabrication of custom finish carpentry.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Protect work from moisture damage.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.8 COORDINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.

- B. Coordinate work with plumbing rough-in, electrical rough-in and installation of associated and adjacent components.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Wall Trim: Wood species (maple) and stain finish to match suspended Wood Ceilings.

2.2 ACCESSORIES

- A. Adhesive: Solvent release, cartridge-type, compatible with substrate, capable of achieving durable bond.
- B. Fasteners: Of size and type to suit application; finish nails or self-tapping bugle head steel screws, hot-dipped galvanized for exterior work.
- C. Concealed Joint Fasteners: Threaded steel.
- D. Wood Filler: Solvent base, tinted to match surface finish color.

2.3 FABRICATION

- A. Fabricate to WIC Premium standards.
- B. Shop assemble work for delivery to site, permitting passage through building openings.
- C. When necessary to cut and fit on site, fabricate materials with ample allowance for cutting. Furnish trim for scribing and site cutting.

2.4 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Apply wood filler in exposed nail and screw indentations.
- C. On items to receive transparent finishes, use wood filler matching surrounding surfaces and of types recommended for applied finishes.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify adequacy of backing and support framing.
- C. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.
- D. Beginning of installation means acceptance of substrate.

3.2 INSTALLATION

- A. Install work in accordance with WIC Premium Quality Standard.
- B. Set and secure materials and components in place, plumb and level.
- C. All trim and millwork shall have mitered joints unless otherwise noted or directed by the Architect. Verify all joint locations.
- D. All joints shall be tight and shall not separate. Stagger joints where members are adjacent.
- E. Exposed nails shall be set and filled. Review nailing pattern with Architect prior to installation of finish carpentry.
- F. Screw, do not drive, all wood screws.
- G. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.

H. Install hardware supplied by Section 087100.

3.3 ERECTION TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Maximum Variation from Indicated Position: 1/16 inch.
- C. Maximum Offset from Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

SECTION 06410
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes custom-fabricated, plastic laminate-faced cabinet units; cabinet hardware; preparation for installing utilities in cabinets; and finishing.
- B. Related Sections:
 - 1. Section 018113 – Sustainable Design Requirements
 - 2. Section 061000 – Rough Cabinetry
 - 3. Section 062000 – Finish Cabinetry
 - 4. Section 123661 – Quartz Surfacing Countertops

1.2 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.
- C. Product Data: Submit data for hardware accessories.

1.3 QUALITY ASSURANCE

- A. Perform work in accordance with AWI (Architectural Woodwork Institute) Architectural Woodwork Quality Standards Illustrated, Custom Grade and WI (Woodwork Institute) Manual of Millwork, Custom Grade.
- B. Surface Burning Characteristics: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.4 QUALIFICATIONS

- A. Fabricator: Company specializing in performing Work of this section with minimum five years documented experience.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Provide materials that comply with reference standard and specified requirements.
- B. Formaldehyde Free: composite wood products with no added formaldehyde, made without urea-formaldehyde adhesives or binders.
- C. Softwood Lumber: NIST PS 20; Graded in accordance with WI Manual of Millwork, Grade II/Custom; average moisture content of 5-10%.
- D. Particleboard: ANSI A208.1 Grade M-2, minimum density 45 pcf, maximum moisture content 8%.
- E. Hardboard: ANSI/AHA A135.4
- F. Medium Density Fiberboard (MDF): ANSI/AHA A208.2, Class MD, formaldehyde-free. Sierra Pine Medex, or equal.
- G. Medium Density Fiberboard, Moisture Resistant (MDF MR) ANSI/AHA A208.2, Class MR, moisture resistant, formaldehyde-free. Georgia-Pacific Ultrastock MR, or equal.
- H. Softwood Plywood: PS 1, APA shop grade except APA Marine MDO where "Marine" is indicated. No added Formaldehyde.

- I. HPDL, High Pressure Decorative Laminate: NEMA LD 3 and the following patterns and colors: Standard Colors by Architect/Owners.
- J. TDO: Thermoset Decorative Overlay: Thermally fused, melamine-impregnated paper complying with LMA SAT-1 on base specified in this Section. Color: White.

2.2 PLASTIC LAMINATE CLAD CABINETS

- A. Grade: Custom
- B. Style: Flush overlay, typical casework.
- C. Core: Particle Board.
- D. Plastic Laminate Cladding:
 - 1. Exposed Horizontal Surfaces: HPDL HGS.
 - 2. Exposed Vertical Surfaces: HPDL VGS.
 - 3. Post-Formed Horizontal Surfaces: HPDL HGP
 - 4. Interior faces of Doors: HPDL VGS, match exposed face.
 - 5. Other Semi-exposed Surfaces: TDO or HPD. Color: White.
 - 6. Semi-Exposed Backs: TDO or HPDL. Color: White.
- E. Edge Cladding: .020 PVC banding. Color to match face.
- F. Color: Cabinet Faces = Nevamar Clear Maple WM8340T, Countertops = Formica Graphite 837-58.

2.3 FABRICATION

- A. Quality Standard: Comply with AWI Section 400, Division 400C.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber in relation to relative humidity conditions existing during time of fabrication and installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of cabinets and edges of solid wood (lumber) members less than 1" in nom. thickness: 1/16"
 - 2. Edges of rails and similar members more than 1 inch nominal thickness: 1/8".
- D. Complete fabrication, including assembly, finishing, and hardware application, before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- E. Factory-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Field cutting of sink and grommet cutouts allowed. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges of cutouts with a water resisting coating.
- F. Rear edges of upper cabinets shall be concealed. No rear of any cabinet shall be exposed. Rears of upper cabinets shall be inserted into rabbits to allow for scribe for a tight fit against wall.
- G. Edges of Components: Pressure bonded to core with waterproof, hot melt adhesive at exposed and semi-exposed edges.
 - 1. HPDL laminated cabinets: .020 PVC banding. Color to match face.
- H. Drawer Box Construction: Lock shoulder.

- I. Shelf Supports: Recessed standards with adjustable shelf support, 4 at shelves 32" wide and less, 5 at shelves wider than 32".
- J. Shelves: 3/4 inch thick core less than 32", 1 inch thick core greater than 32" any dimension.
- K. All cabinetry enclosing flipper door hardware to be completely removable for access and removal of flipper door hardware.

2.4 HARDWARE

- A. Hardware Finish (unless otherwise noted): 626 Dull Chrome.
- B. Shelf Supports: Knappe and Vogt 346 NP, four per shelf, spaced at 1-1/4 inches o.c.
- C. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers, Baldwin 4676. Two required for drawers over 18 inches wide; one per door leaf.
- D. Cabinet Locks: National lock C-8105 pin tumbler, finish to match cabinet hardware. Keyed cylinder, two keys for each lock, master keyed.
- E. Catches: Touch type.
- F. Drawer Slides: Cold rolled steel construction, ball bearings separating tracks, side mounted, full extension type, heavy duty grade. Wurth Louis and Company Pro 2.0 Series.
- G. Hinges: European style concealed self-closing type, steel with polished finish. Blum 75M 1580, 107 with meeting plate for Hush overlay design.
- H. Rubber Bumpers: Provide for all drawers.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Before installing casework, examine shop-fabricated work for completion and complete work as required. Measure all areas for scribe fit.

3.2 INSTALLATION

- A. Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.
- B. Install casework plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8" in 8'-0" for plumb and level and with no variations in flushness of adjoining surfaces.
- C. Scribe and cut casework to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
- D. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.
 - 1. Mount wall cabinets to resist 200 pounds per lineal foot.
- F. Sinks: Verify sink locations and sizes before cutting openings in countertops.
- H. Complete the finishing work specified in this section to whatever extent not completed at shop or before installation of casework.

3.3 ADJUSTMENT AND CLEANING

- A. Repair damaged and defective casework where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

- B. Clean, lubricate and adjust hardware.
- C. Clean casework on exposed and semi-exposed surfaces Touch up factory-applied finishes to restore damaged or soiled areas.

3.4 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer. Ensure that casework is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 066410
FIBERGLASS REINFORCED PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Fiberglass reinforced polyester panel system for adhesive mounting.
- B. Accessories.

1.2 REFERENCES

- A. ASTM D 570 - Standard Test Method for Water Absorption of Plastics; 1998.
- B. ASTM D 968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2005.
- C. ASTM D 2197 - Standard Test Methods for Adhesion of Organic Coatings by Scrape Adhesion; 1998 (Reapproved 2004).
- D. ASTM D 2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor; 1995 (Reapproved 2001).

1.3 SUBMITTALS

- A. Product Data: Manufacturer's data sheets, including preparation, installation and maintenance.
- B. Samples for selection..
- C. Samples for verification.

1.4 QUALITY ASSURANCE

- A. Installer shall have experience installing similar systems on commercial projects of this size.
- B. Meet the following standards:
 - 1. ASTM D 570 for absorption.
 - 2. ASTM D 968 for abrasion.
 - 3. ASTM D 2197 for adhesion of coatings.
 - 4. ASTM D 2583 for hardness.
- C. Warranty: Provide warranty against any deterioration of surface that might occur under normal use for a period of five (5) years following Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers:
 - 1. Marlite. (Basis of Design)
 - 2. Kemlite Company.
 - 3. Or approved equal.
- B. Products:
 - 1. Panels:
 - a. Marlite FRP Panels USDA approved for incidental food contact.
 - b. Tensile strength: 8,000 p.s.i.
 - c. Hardness: 40.
 - d. Impact resistance: 7 lb./in.
 - e. Absorption: 0.17 %.
 - f. Surface texture: Smooth.
 - g. Color: As selected by Architect from manufacturer's full range of standard colors.
 - 2. Panel Trim:
 - b. Manufacturers standard Aluminum Trim Molding:
 - 1) Inside Corner
 - 2) Edge
 - 3. Adhesive: Comply with VOC requirements.
 - 4. Sealant: Comply with VOC requirements as noted in Section 07 92 00 - Joint Sealers.

- a. Silicone, Clear.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspect substrates to confirm they are firmly attached, clean and suitable for adhesive installation of panels. Do not proceed if substrates are unacceptable.

3.2 INSTALLATION

- A. Install over surfaces indicated in Drawings.
- B. Install in a continuous operation from one corner and continuing across surfaces to be covered.
- C. At seams install continuous bead of sealant at each joint and trim groove and at edges. Allow 1/8 inch between panels for expansion.
- D. Protect installed panels from damage during remainder of construction period.
- E. Touch-up, repair and replace damaged products prior to Substantial Completion.

3.3 SCHEDULE

- A. Location:
 - 1. Janitor's closet:
 - a. Provide FRP Paneling above mop sink as shown on interior elevations.

END OF SECTION

SECTION 072100 INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sound Batt Insulation
 - 2. Acoustical Blanket Insulation
 - 3. Cellulose Insulation: Pneumatically blown dry into building assemblies.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. C665 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Wood Frame and Light Construction Buildings.
 - 2. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C.

1.3 SUBMITTALS

- A. See Section 01 30 00 – Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- D. Quality Control Submittals:
 - 1. Certificates of Compliance: Certification from an independent testing laboratory that insulation meets fire hazard classification requirements.

1.4 QUALITY ASSURANCE

- A. Insulation Labeling: An R-value identification mark shall be applied (by manufacturer) to each piece of insulation 12 inches or greater in width. Alternately, the insulation installers shall provide a signed, dated, and posted certification listing the type, manufacturer, and R-value of insulation installed.
- B. Fire Hazard Classification:
 - 1. Noncombustible, tested to ASTM E136.
 - 2. Flame spread/smoke developed rating of 25/50 or less, tested to ASTM E84.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store insulation in clean, dry, sheltered area, off ground or floor, until used. Protect against wetting and moisture absorption.

1.6 PROJECT CONDITIONS

- A. Do not install insulation until building is substantially water and weather tight.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Owens Corning. (www.owenscorning.com)

2. Johns Manville. (www.jm.com)
 3. Knauf Insulation. (www.knaufinsulation.us)
 4. Thermafiber. (www.thermafiber.com)
 5. Nu-Wool Company. (www.nuwool.com)
- B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Glass Fiber Batt Insulation: Flexible preformed Batt, complying with ASTM C665, friction fit.
1. Type: ASTM C665, glass fiber composition.
 2. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
 3. All batt insulation shall meet flame/smoke properties requirements of ASTM E84 unless otherwise noted.
 4. Facing: Unfaced. Free from urea-formaldehyde resins.
 6. Sound batt insulation where indicated or noted on drawings as "sound insulation".
- B. Black Faced Mineral Wool Acoustical Blanket Insulation: Preformed blanket, complying with ASTM C665.
1. Basis of Design: – Thermafiber, SoundZero.
 2. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
 3. All batt insulation shall meet flame/smoke properties requirements of ASTM E84 unless otherwise noted.
 4. Acoustical Performance: NRC 0.70, complies with ASTM C423.
 5. Facing: Fabric-Faced (black). Free from urea-formaldehyde resins.
 7. Thickness: 1 inch.
 8. Density: 1.5 pcf.
- C. Cellulose Insulation: Pneumatically blown dry into enclosed wall assemblies.
1. Material description:
 - a. Manufactured from recycled newspapers
 - b. Post-Consumer Recycled Content: 85 percent minimum.
 - c. Fibers: Treated with boric acid and sodium polyborate additives to create permanent flame resistance.
 - d. Fungicide Additive:
 - i. EPA registered.
 - ii. Makes insulation resistant to mold growth.
 2. Compliance:
 - a. UL classification R-8078.
 - b. CPSC Standard 16 CFR Parts 1209 and 1404.
 - c. ASTM C 739.
 - d. ASTM E 119: Firewalls U382, U369a, U369b, U360.
 - e. ES Report ESR-2217.
 3. Test Results:
 - a. Settled Density: Maximum density after long-term settling of dry installation: 1.6 lbs per cu ft.
 - b. Thermal Resistance: Average thermal resistance (R-value) per inch: 3.8.
 - c. Flammability Characteristics:
 - i. Critical Radiant Flux: 0.12 W/cm² minimum.
 - ii. Smoldering Combustion: No evidence of flaming and weight loss of 15.0 percent maximum.
 - d. Moisture Gain in Insulation: 15 percent maximum by weight.
 - e. Surface Burning Characteristics, ASTM E 84 and UL 723:
 - i. Flame Spread Index: 15
 - ii. Smoke Developed Index: 5.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Butt insulation to adjacent construction. Butt ends and edges. Do not compress insulation.
- C. Carry insulation around pipes, wiring, boxes, and other components. Trim insulation neatly.
- D. Ensure complete enclosure of spaces without voids.
- E. Protect insulation from damage prior to concealment.
- F. Install cellulose insulation to uniform density without voids, gaps, or air pockets.
- G. Install cellulose insulation to density of 1.6 to 3.5 lbs. per cu. ft.
- H. Install cellulose insulation after mechanical, plumbing, electrical, and other utility installations have been completed.

3.2 SCHEDULES

- A. Sound Batt Insulation:
 - 1. Partitions noted with "sound insulation" or shown with sound insulation: 3 1/2 inch thick, unfaced.
 - 2. Ceilings noted with batt insulation or sound insulation: 14 inch thick, unfaced.
 - 3. Roof framing noted with batt insulation: 12 1/2 inch thick, unfaced.
- B. Acoustic Blanket Insulation:
 - 1. Wood Slat Acoustical walls with "rock wool insulation": rock wool or duct liner, 1 inch thick, black faced.
- C. Cellulose Insulation:
 - 1. Existing plywood faces shear walls: fill all stud cavities.

END OF SECTION

SECTION 072113
BOARD INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Board insulation at existing concrete walls.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. C578 - Standard Specification for Rigid Cellular Polystyrene Thermal Insulation.
 - 2. C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - 3. C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - 4. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 5. E96/E96M - Standard Test Method for Water Vapor Transmission of Materials.
 - 6. E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Product Data: Indicate product composition and performance characteristics.

1.4 QUALITY ASSURANCE

- A. Fire Hazard Classification:
 - 1. Noncombustible, tested to ASTM E136.
 - 2. Maximum flame spread/smoke developed rating of 25/50 tested to ASTM E84.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store insulation in clean, dry, sheltered area, off ground or floor, until used. Protect against wetting and moisture absorption.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers – Polyisocyanurate Insulation:
 - 1. Rmax, Inc. (www.rmaxinc.com)
 - 2. Hunter Panels (www.hpanels.com)
- B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Board Insulation:
 - 1. Basis of Design: Rmax Thermasheath -3.
 - 2. ASTM C 1289 Type 1, closed cell polyisocyanurate foam bonded to reinforced aluminum foil facers.
 - 3. Minimum compressive strength: 20 PSI.

4. Thermal resistance: Minimum LTTR value of 6 per inch.
5. Water vapor permeance: Maximum 0.3 perms for 1 inch thickness, tested to ASTM E96/E96M.

2.3 ACCESSORIES

- A. Adhesive:
 1. Type recommended by insulation manufacturer.
- B. Tape: Minimum 2 inches wide, pressure sensitive, waterproof.
- C. Fasteners: Type best suited to application, hot-dip galvanized steel.

PART 3 EXECUTION

3.1 PREPARATION

- A. Substrate:
 1. Remove protrusions flush with adjacent surface.
 2. Remove dirt, dust, oil, grease, and other materials that could impair adhesion.

3.2 INSTALLATION

- A. Apply adhesive in full bed 1/8 inch thick.
- B. Place boards in a method to maximize contact bedding.
- C. Butt edges and ends tight to adjacent boards, at perimeter, and around penetrations with maximum 1/4 inch gaps.
- D. Tape seal to perimeter and at joints between insulation pieces.

END OF SECTION

SECTION 079200
JOINT SEALERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Joint backup materials.
 - 2. Joint sealers.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. C510 - Standard Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants.
 - 2. C719 - Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle).
 - 3. C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants.
 - 4. C834 - Standard Specification for Latex Sealing Compounds.
 - 5. C919 - Standard Practice for Use of Sealants in Acoustical Applications.
 - 6. C920 - Standard Specification for Elastomeric Joint Sealants.
 - 7. C1193 - Standard Guide for Use of Joint Sealants.
 - 8. C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants.
 - 9. C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
 - 10. C1472 - Standard Guide for Calculating Movement and Other Effects When Establishing Sealant Joint Width.
 - 11. C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
 - 12. D2203 - Standard Test Method for Staining from Sealants.
 - 13. D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Product Data: Indicate sealers, primers, backup materials, bond breakers, and accessories proposed for use.
 - 2. Warranty: Sample warranty form.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Minimum 5 years documented experience in work of this Section.
- B. Maximum Volatile Organic Compound (VOC) Content; interior sealers and accessories:
 - 1. Sealers: 250 grams per liter.
 - 2. Primers for non-porous substrates: 250 grams per liter.
 - 3. Primers for porous substrates: 775 grams per liter.
- C. Laboratory Pre-Construction Testing:
 - 1. Obtain representative samples of actual substrate materials.
 - 2. Test sealers and accessories for following:
 - a. Adhesion: Test to ASTM C794 and ASTM C719; determine surface preparation and required primer.

- b. Compatibility: Test to ASTM C1087; determine that materials in contact with sealers do not adversely affect sealant materials or sealant color.
- c. Staining: Test to ASTM D2203, ASTM C510, or ASTM C1248; determine that sealants will not stain joint substrates.
- d. Pre-construction testing is not required when sealant manufacturer furnishes data acceptable to Architect based on previous testing for materials matching those of this Project.

1.5 PROJECT CONDITIONS

- A. Do not apply sealers at temperatures below 40 degrees F unless approved by sealer manufacturer.

1.6 WARRANTIES

- A. Furnish manufacturer's 10 year warranty providing coverage for exterior sealers and accessories that fail to provide air and water tight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. BASF Building Systems. (www.buildingsystems.basf.com)
 - 2. Dow Corning Corp. (www.dowcorning.com)
 - 3. GE Silicones. (www.siliconeforbuilding.com)
 - 4. Pecora Corp. (www.pecora.com)
 - 5. Sika Corp. (www.sikausa.com)
 - 6. Tremco, Inc. (www.tremcosealants.com)
- B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Joint Sealer Type 1:
 - 1. ASTM D6690, Type 1, hot-poured polymer modified asphalt.
 - 2. Movement capability: Plus or minus 25 percent.
 - 3. Color: Black.
- B. Joint Sealer Type 2:
 - 1. ASTM C920, Grade P, multiple component polyurethane type, self-leveling and slope grades.
 - 2. Movement capability: Plus or minus 25 percent.
 - 3. Color: To be selected from manufacturer's full color range.
- C. Joint Sealer Type 3:
 - 1. ASTM C920, Grade NS, single component polyurethane type, non-sag.
 - 2. Movement capability: Plus or minus 25 percent.
 - 3. Color: To be selected from manufacturer's full color range.
- D. Joint Sealer Type 4:
 - 1. ASTM C920, Grade NS, single component silicone type, non-staining, non-sag.
 - 2. Movement capability: Plus or minus 25 percent.
 - 3. Color: To be selected from manufacturer's full color range.
- E. Joint Sealer Type 5:
 - 1. ASTM C920, Grade NS, single component butyl rubber type, non-sag.
 - 2. Movement capability: Plus or minus 12-1/2 percent.
 - 3. Color: To be selected from manufacturer's full color range.

- F. Joint Sealer Type 6:
 - 1. ASTM C834, single component acrylic latex, non-sag.
 - 2. Movement capability: Plus or minus 7-1/2 percent.
 - 3. Color: White.
- G. Joint Sealer Type 7:
 - 1. ASTM C920, Grade NS, single component silicone, non-sag, mildew resistant.
 - 2. Movement capability: Plus or minus 25 percent.
 - 3. Color: To be selected from manufacturer's full color range.
- H. Joint Sealer Type 8:
 - 1. ASTM C920, Grade NS, single component polyurethane type, non-sag, recommended by manufacturer for continuous water immersion.
 - 2. Movement capability: Plus or minus 25 percent.
 - 3. Color: To be selected from manufacturer's full color range.
- I. Joint Sealer Type 9:
 - 1. ASTM C834, single component acrylic latex, non-sag, non-hardening, non-corrosive, recommended by manufacturer for acoustical applications.
 - 2. Movement capability: Plus or minus 7-1/2 percent.
 - 3. Color: White.

2.3 ACCESSORIES

- A. Primers, Bond breakers, and Solvents: As recommended by sealer manufacturer.
- B. Joint Backing:
 - 1. ASTM C1330, closed cell polyethylene foam, preformed round joint filler, non-absorbing, non-staining, resilient, compatible with sealer and primer, recommended by sealer manufacturer for each sealer type.
 - 2. Size: Minimum 1.25 times joint width.

2.4 MIXES

- A. Mix multiple component sealers in accordance with manufacturer's instructions.
 - 1. Mix with mechanical mixer; prevent air entrainment and overheating.
 - 2. Continue mixing until color is uniform.

PART 3 EXECUTION

3.1 PREPARATION

- A. Remove loose and foreign matter that could impair adhesion. If surface has been subject to chemical contamination, contact sealer manufacturer for recommendation.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Protect adjacent surfaces with masking tape or protective coverings.
- D. Calculate joint dimensions in accordance with ASTM C1472.

3.2 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Install sealers and accessories in accordance with ASTM C1193.
- C. Install acoustical sealers and accessories in accordance with ASTM C919.
- D. Install joint backing to maintain required sealer dimensions. Compress backing approximately 25 percent without puncturing skin. Do not twist or stretch.
- E. Use bond breaker tape where joint backing is not installed.
- F. Fill joints full without air pockets, embedded materials, ridges, and sags.
- G. Tool sealer to smooth profile.

H. Apply sealer within manufacturer's recommended temperature range.

3.3 CLEANING

- A. Remove masking tape and protective coverings after sealer has cured.
- B. Clean adjacent surfaces.

3.4 SCHEDULE

JOINT LOCATION OR TYPE	SEALER TYPE
Exterior Joints:	
Joints in horizontal surfaces subject to pedestrian or vehicular traffic	1
Joints in above-grade surfaces	3,4,5
Interior Joints:	
Joints in horizontal surfaces subject to pedestrian traffic	2
Joints in toilet rooms, countertops, kitchens	7
Joints in acoustical assemblies	9
Other joints	6

END OF SECTION

SECTION 081113

HOLLOW METAL DOORS AND FRAMES

GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hollow steel doors and frames.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 087100 - Door Hardware.
 - 3. Section 088000 - Glazing.

1.2 REFERENCES

- A. American National Standards Institute (ANSI)/Steel Door Institute (SDI):
 - 1. A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finished Painted Steel for Steel Doors and Frames.
 - 2. A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings.
 - 3. A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
 - 4. A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
 - 5. A250.11 - Recommended Erection Instructions for Steel Frames.
- B. ASTM International (ASTM):
 - 1. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - 2. A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 3. A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 4. C518 - Standard Test Method for Steady State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 5. E413 - Classification for Rating Sound Insulation.
- C. National Fire Protection Association (NFPA) 80 - Standard for Fire Doors and Fire Windows.
- D. Steel Door Institute (SDI) 117 - Manufacturing Tolerances for Standard Steel Doors and Frames.
- E. Underwriters Laboratories (UL):
 - 1. 10B - Standard for Fire Tests of Door Assemblies.
 - 2. 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Shop Drawings: Show locations, elevations, dimensions, model designations, thermal, acoustical ratings, preparation for hardware, and anchoring details.
 - 2. Product Data: Show elevations, dimensions, gages of metal, hardware reinforcing gages and locations, and anchor types.
- B. Quality Control Submittals:
 - 1. Certificates of Compliance: Certification that products furnished comply with ANSI/SDI A250.3, ANSI/SDI 250.4, and ANSI/SDI A250.10.
- C. Sustainable Design Submittals:
 - 1. Recycled Content.
 - 2. Regional Materials.

1.4 QUALITY ASSURANCE

- A. Doors: ANSI/SDI A250.8.

1. Grade: III – Extra Heavy Duty.
 2. Model: 1 - Full Flush.
 3. Exterior doors: Maximum thermal transmittance (U-value) of 0.70, tested to ASTM C518.
- B. Frames: ANSI/SDI A250.8, Grade II - Heavy Duty.
- C. Fire Door and Frame Construction: Conform to UL 10B and UL 10C.
- D. Installed Fire Rated Door and Frame Assemblies: Conform to NFPA 80.
- E. Acoustic Door and Frame Assemblies: Minimum STC rating of 40, measured in accordance with ASTM E413.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Ship door frames with removable angle spreader; do not remove until frame is installed.
- B. Store doors upright in protected, dry area, off ground or floor, with at least 1/4 inch space between individual units.
- C. Do not cover with non-vented coverings that create excessive humidity.
- D. Remove wet coverings immediately.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
1. Steelcraft. (www.steelcraft.com)
 2. Ceco Door. (www.cecodoor.com)
- B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Commercial quality carbon steel conforming to ASTM A568 and A569.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum metallic coating.
- C. Frame Anchors: ASTM A 591/A 591M
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Mineral-Fiber Insulation: ASTM C 665, Type I.
- F. Glazing: Division 08 Section "Glazing."

2.3 STANDARD HOLLOW METAL DOORS

- A. General: Comply with ANSI/SDI A250.8.
1. Design: Flush panel.
 2. Core Construction: Manufacturer's standard polyisocyanurate at exterior doors.
 - a. Exterior Thermal-Rated (Insulated) Doors: Per ICBO
 3. Vertical Edges for Single-Acting Doors: Manufacturer's standard.
 4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.
 5. Tolerances: SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Comply with ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush)
- C. Hardware Reinforcement: ANSI/SDI A250.6.

2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
1. Fabricate frames with mitered or coped corners.
 2. Fabricate frames as face welded, unless otherwise indicated.
 3. Frames for Level 3 Steel Doors: 0.053-inch- thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled steel sheet.

1. Fabricate frames with mitered or coped corners.
 2. Fabricate frames as face welded unless otherwise indicated.
 3. Frames for Level 3 Steel Doors: 0.053-inch- thick steel sheet.
- D. Hardware Reinforcement: ANSI/SDI A250.6.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
 2. Post-installed Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.6 FABRICATION

- A. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- B. Hollow Metal Doors:
1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors. Seal joints in top edges of doors against water penetration.
- C. Hollow Metal Frames: Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Provide six anchors per jamb for doors wider than 36 inches.
 - 6) Two anchors per head for frames more than 36 inches wide and mounted in metal-stud partitions.
 - c. Compression Type: Not less than two anchors in each jamb.
 - d. Post-installed Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers.
 - a. Single-Door Frames: Three door silencers.
 - b. Double-Door Frames: Two door silencers.

- D. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 - 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 - 2. Reinforce doors and frames to receive non-templated, mortised and surface-mounted door hardware.
 - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 - 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 electrical Sections.
- E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 4. Provide loose stops and moldings on inside of hollow metal work.
 - 5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.7 FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pre-treating.
 - 1. Shop Primer: ANSI/SDI A250.10.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Hollow Metal Frames: Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Wood-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 - 4. Concrete Walls: Coordinate installation of frames to allow for solidly filling space between frames and walls with insulation. Secure frames in place with post-installed expansion anchors at each jamb.
 - 5. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

- b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- B. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
- C. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
 - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.2 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION

SECTION 082120
FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Solid core doors with wood veneer faces; flush configuration.
 - 2. Field installed veneer faced flush doors in hollow metal frames.
- B. Related Sections:
 - 1. Section 081113 – Hollow Metal Frames.
 - 2. Section 087100 - Door Hardware.
 - 3. Section 088000 - Glazing.

1.2 REFERENCES

- A. American Society for Testing and Materials:
 - 1. ASTM E413 - Standard Classification for Rating Sound Insulation.
- B. Architectural Woodwork Institute:
 - 1. AWI - Quality Standards Illustrated.
- C. Hardwood Plywood and Veneer Association:
 - 1. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.
- D. National Fire Protection Association:
 - 1. NFPA 80 - Standard for Fire Doors, Fire Windows.
 - 2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
- E. Underwriters Laboratories Inc.:
 - 1. UL 10B - Fire Tests of Door Assemblies.
 - 2. UL - Building Materials Directory.
- F. Uniform Building Code
 - 1. UBC Standard 7-2 - Fire Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, factory finishing criteria, identify cutouts for glazing and louvers.
- C. Product Data: Submit information on door core materials and construction, and on veneer species, type and characteristics.
- D. Samples: Submit two samples of door veneer, 3 x 3 inch in size illustrating wood grain, stain color, and sheen.
- E. Manufacturer's Installation Instructions: Submit special installation instructions.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with AWI Quality Standard Section 1300, Premium Grade.
- B. Finish doors in accordance with AWI Quality Standard Section 1500.
- C. It is the intent of this specification to provide a general guideline for quality, function, and design of the Wood Doors and Frames. It is specific responsibility of Wood Doors and Frames Supplier to furnish products which are fully functional, in full compliance with State and Local Building Codes, Fire Codes, and Handicap Codes. Any supplier bidding on this section of work will notify the Architect prior to bidding of discrepancies or will be assumed to have included correct material to make this compliance.

- D. It shall be the Contractor's sole responsibility to measure each existing or new rough opening and overall wall thickness, including existing and proposed wall finishes, prior to fabrication of doors and frames.
- 1.5 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Section 016000 - Product Requirements: Product storage and handling requirements.
 - B. Package, deliver and store doors in accordance with AWI Section 1300.
 - C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer when stored more than one week.
 - 1. Break seal on site to permit ventilation.
- 1.7 COORDINATION
- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
 - B. Coordinate Work with door opening construction, door frame and door hardware installation.
- 1.8 WARRANTY
- A. Section 017000 - Execution Requirements: Product warranties and product bonds.
 - B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.
 - C. Furnish manufacturer's "Life of Installation" warranty for interior doors.

PART 2 PRODUCTS

- 2.1 INTERIOR SOLID-CORE DOORS
- A. Manufacturers:
 - 1. Algoma Hardwoods Inc.
 - 2. Eggers Industries.
 - 3. Marshfield Door Systems
 - 4. Weyerhaeuser Company.
 - 5. Vancouver Door.
 - 6. VT Industries.
 - 7. Substitutions: Section 016000 - Product Requirements.
 - B. Product Description: Extra heavy duty solid core flush wood doors; wood veneer facing; factory clear finish.
 - 1. Flush Interior Doors: 1-3/4 inches thick; solid core, five ply construction, as indicated on Drawings.
- 2.2 COMPONENTS
- A. Solid Core: AWI Section 9, Solid, non-rated particleboard core.
 - B. Veneer Faces: Maple veneer, grade A. See Door Schedule.
 - 1. Plain sliced maple with clear finish.
 - C. Exposed Vertical Edges: Wood species to match faces, 1/2" minimum thickness.
 - D. Horizontal Edges: Structural composite lumber.
 - E. Adhesive: WDMA Type I - waterproof.
 - F. Factory Finish: Meets WDMA TR-8 and AWS System 9. Seal top and bottom rails.

2.4 FABRICATION

- A. Fabricate doors in accordance with AWI Quality Standards requirements.
- B. Sound Rating for Single Door Leaf and Frame Assembly: ASTM E413, minimum STC 35.
- C. Furnish lock blocks at lock edge and top of door for closer for hardware reinforcement.
- D. Vertical Exposed Edge of Stiles: Of same species as veneer facing.
- E. Fit door edge trim to edge of stiles after applying veneer facing.
- F. Bond edge banding to cores.
- G. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware. Furnish solid blocking for through bolted hardware.
- H. Factory fit doors for frame opening dimensions identified on shop drawings.
- I. Provide edge clearances in accordance with AWI 1300.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify 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.

3.2 INSTALLATION

- A. Install fire rated and non-rated doors in accordance with AWI Quality Standard, NFPA 80, and to requirements for fire rating label by UL.
- B. DO NOT TRIM factor finished doors for width.
- C. Trim door height by cutting bottom edges to maximum of 3/4 inch.
 - 1. Trim fire door height at bottom edge only, seal bottom edge after trimming with clear sealer approved by door manufacturer.
- D. Machine cut doors for hardware installation.
- E. Coordinate installation of doors with installation of frames specified in Section 081113 and hardware specified in Section 087100.

3.3 INSTALLATION TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Conform to AWI requirements for fit and clearance tolerances.
- C. Conform to AWI Section 1300 requirements for maximum diagonal distortion.

3.4 ADJUSTING

- A. Section 017000 - Execution Requirements: Testing, adjusting, and balancing.
- B. Adjust door for smooth and balanced door movement.
- C. Adjust closer for full closure.

END OF SECTION

SECTION 087100 DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hardware for interior and exterior doors.
 - 2. Hardware for other sections referencing this section.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):
 - 1. A156.1 - Butts and Hinges.
 - 2. A156.2 - Bored and Preassembled Locks and Latches.
 - 3. A156.4 - Door Controls - Closers.
 - 4. A156.5 - Auxiliary Locks and Associated Products.
 - 5. A156.13 - Mortise Locks and Latches.
 - 6. A156.18 - Materials and Finishes.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Shop Drawings: Schedule hardware by door type and location; show door size, hand, thickness, edge bevel, hardware components and quantities, keying, and finishes.
 - 2. Product Data: Manufacturer's descriptive data for each component.
 - 3. Warranty: Sample warranty form.
- B. Closeout Submittals:
 - 1. Copy of approved hardware schedule.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 10 years documented experience in work of this Section.
- B. Conform to ICC A117.1-2009 Accessible and Usable Buildings and Facilities for locating hardware and for door opening force requirements.
- C. Pre-Installation Conference:
 - 1. Convene at site prior to ordering permanent cylinders for Project.
 - 2. Attendance: Architect, Owner, Contractor, and hardware supplier.
 - 3. Review, discuss, and finalize Owner's keying requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Pack hardware items separately, with fasteners, installation instructions, and templates.
- B. Mark containers with item number corresponding to hardware schedule.

1.6 WARRANTIES

- A. Furnish manufacturer's standard warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Butts: Stanley (www.stanleyhardware.com)
- B. Locks: Schlage. <http://www.schlage.com>
- C. Closers: LCN by Allegion. (www.allegion.com)
- D. Push – Pulls: Trimco. (www.trimcohardware.com)
- E. Flushbolts, Kickplates, Stops: Ives by Allegion. (www.allegion.com)
- F. Gaskets: Steelcraft by Allegion. (www.allegion.com)
- G. Substitutions: Under provisions of Division 01.

2.2 MANUFACTURED UNITS

- A. Butt Hinges:
 - 1. Description: ANSI/BHMA A156.1, full mortise type, five knuckle, non-rising pin, hole in bottom tip for pin removal.
 - 2. Exterior outswinging doors: Provide set screw in barrel making hinge non-removable when door is closed.
 - 3. Weight: Standard weight.
 - 4. Bearing type: Ball bearing.
 - 5. Size: 4-1/2 x 4-1/2 inches.
- B. Locksets, Latchsets, Deadbolts, and Cylinders:
 - 1. Locksets and latchsets:
 - a. Type: A156.2, Grade 1, cylindrical, key-in-lever handles.
 - b. Lever design: Schlage “Rhodes” style.
 - 2. Deadbolts:
 - a. Type: ANSI/BHMA A156.5, cylindrical type with 1 inch bolt throw.
 - b. Functions: As scheduled.
 - 3. Strike plates: Curved lip, minimum lip projection necessary to protect door frame and trim and to conceal edges of strike cutout.
 - 4. Strike boxes: Steel.
 - 5. Cylinders: Six pin, solid brass, removable core type.
 - 6. Keyway: Schlage E to match existing building.
 - 7. Keys: Solid brass or nickel silver.
 - 8. Keying:
 - a. Furnish cylinders with 2 blank keys for each cylinder to SOU for final keying by SOU.
- C. Closers:
 - 1. Conform to ANSI A156.4, Grade 1.
 - 2. Closers shall conform to the following:
 - a. The closer shall have minimum 50 percent adjustable closing force over minimum value for that closer and have adjustable hydraulic back check effective between 60 degrees and 85 degrees of door opening.
 - b. Where specified, closer shall have hold-open feature.
 - c. Size Requirements: Size closers in accordance with manufacturer’s recommendations or provide multi-size closers, sizes 1 through 6 except where multi-size closer is not available for the required application.
 - d. Material of closer body shall be forged or cast iron.
 - e. Arm and brackets for closers shall be steel, malleable iron or high strength ductile cast iron.
 - f. Closers shall have full size metal cover; plastic covers will not be accepted.
 - g. Closers shall have adjustable hydraulic back-check, separate valves for closing and latching speed, adjustable back-check positioning valve, and adjustable delayed action valve.

- h. Provide closers with any accessories required for the mounting application, including (but not limited to) drop plates, special soffit plates, spacers for heavy-duty parallel arm fifth screws, bull-nose or other regular arm brackets, longer or shorter arm assemblies, and special factory templating. Provide special arms, drop plates, and templating as needed to allow mounting at doors with overhead stops and/or holders. Provide shims/spacer plates at doors with vision lites as required to clear vision lite frame.
- i. Closer arms or backcheck valve shall not be used to stop the door from overswing, except in applications where a separate wall, floor, or overhead stop cannot be used.
- j. Provide parallel arm closers with heavy duty rigid arm.
- k. Where closers are to be installed on the push side of the door, provide parallel arm type except where conditions require use of top jamb arm.
- l. Provide all surface closers with the same body attachment screw pattern for ease of replacement and maintenance.
- m. All closers shall have a 1 ½" (38mm) minimum piston diameter
- D. Door Stops: Provide a dome floor or wall stop for every opening as listed in the hardware sets.
 - 1) Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
 - 2) Provide fastener suitable for wall construction.
 - 3) Coordinate reinforcement of walls where wall stop is specified.
 - 4) Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered.
- E. Door Bottoms: See Hardware Schedule.
- F. Push-Pull Plates: Aluminum, beveled edges, 3 1/2 x 15 inches, secured with through bolts.
- G. Door Pulls: 1" dia. profile, 8 inches center-to-center of mounting holes.
- H. Kick Plates:
 - 1. Type: 16 gage, square edges, secured with flathead countersunk screws.
 - 2. Size: 10 inches high x door width less 2 inches.
- I. Silencers: Conform to ANSI A156.16. Provide door mutes or door silencers Type L03011, of white or light gray color, on each steel door frame, except frames for sound-resistant doors. Furnish 3 mutes for single doors and 6 mutes for each pair of doors.
- J. Sound Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.

2.3 FINISHES

- A. See Section 3.4 Schedule
- B. Finishes: To ANSI/BHMA A156.18.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install hardware in accordance with approved hardware schedule and manufacturer's instructions.
- B. Install mortise items flush with adjacent surfaces.
- C. Install locksets, closers, and trim after finish painting.
- D. Mount closers so that closers and closer arms are not visible on corridor or public side of doors or on exterior of building.
- E. Mounting Heights - Finished Floor to Center Line of:
 - 1. Locksets: 38 inches.
 - 2. Push and pull plates: 42 inches.
 - 3. Dead locks: 48 inches.
 - 4. Push pad exit devices: 42 inches.
 - 5. Cross bar exit devices: 38 inches.

6. Top hinge: Maximum 10 inches from frame head.
7. Bottom hinge: Maximum 12-1/2 inches from floor.
8. Intermediate hinges: Equally spaced.

3.2 PROTECTION

- A. Remove or protect hardware until painting is completed.

3.3 ADJUSTING

- A. Test and adjust hardware for quiet, smooth operation, free from binding and rattling.
- B. Adjust doors to operate with maximum opening forces in accordance with applicable accessibility code.

3.4 SCHEDULE

FINISH HARDWARE FOR:

SOU CENTRAL HALL PH#4
ASHLAND, OR

FINISH:

DULL CHROME US26D

MANUFACTURERS SPECIFIED

BUTTS	STANLEY
LOCKS	SCHLAGE
EXIT DEVICE	VON DUPRIN
ELECTRIC STRIKE	VON DUPRIN
CLOSERS	LCN
KICKPLATES	IVES
PUSH/PULL PLATE	TRIMCO
STOPS	IVES
GASKETING	STEELCRAFT
DR BOTTOM/THRESHOLD	NATIONAL GUARD

GROUP 01

DRS 201A, 225A

3 EA	BUTTS FBB179 4.5 X 4.5 NRP
1 EA	EXIT DEVICE CD 99NL X 990NL
1 EA	RIM CYLINDER 20-057
1 EA	MORTISE CYLINDER 20-061 XQ11-948
1 EA	ELECTRIC STRIKE 9600
1 EA	CLOSER 4040XP SCUSH
1 EA	KICKPLATE 8400 10 X 2 LDW
1 EA	DOOR SWEEP 200 NA
1 EA	THRESHOLD 713
1 SET	GASKETING PS074

GROUP 02

DRS 201B, 225B

3 EA	BUTTS FBB179 4.5 X 4.5
1 EA	DUMMY PUSH PAD + PULL 330 X 990DT
1 EA	CLOSER 4040XP SCUSH
1 EA	KICKPLATE 8400 10 X 2 LDW
1 EA	FLOOR STOP FS441
1 SET	GASKETING PS074

GROUP 03

DRS 202A, 203A, 204A, 205A, 206A, 207A, 210A, 211A, 212A, 213A, 217A, 231A

3 EA	BUTTS F179 4.5 X 4.5
1 EA	LOCKSET ND50R RHO
1 EA	WALLSTOP WS406/407CCV
1 SET	GASKETING PS074

GROUP 04

DR 216A

3 EA	BUTTS FBB179 4.5 X 4.5
1 EA	EXIT DEVICE 99L-NL X 996L-NL 06A
1 EA	CYLINDER 20-057
1 EA	CLOSER 4040XP EDA
1 EA	KICKPLATE 8400 10 X 2 LDW
1 SET	GASKETING PS074

GROUP 05

DR 220A, 221A

3 EA	BUTTS FBB179 4.5 X 4.5
1 EA	DEADBOLT B663R
1 EA	PUSH PLATE 1001-3
1 EA	PULL PLATE 1017-3
1 EA	CLOSER 4040XP REGARM
1 EA	KICKPLATE 8400 10 X 2 LDW
1 EA	WALLSTOP WS406/407CCV
1 SET	GASKETING PS074

GROUP 06

DR 222A

3 EA	BUTTS FBB179 4.5 X 4.5
1 EA	MORTISE LOCK L9056R 06A, L583-363, OS-OCC INDICATOR
1 EA	CLOSER 4040XP REGARM
1 EA	KICKPLATE 8400 10 X 2 LDW
1 EA	WALLSTOP WS406/407CCV
1 SET	GASKETING PS074

GROUP 07

DR 224A, 227B, 228A, 230A

3 EA	BUTTS FBB179 4.5 X 4.5
1 EA	LOCKSET ND80R RHO
1 EA	ELECTRIC STRIKE 6211
1 EA	CLOSER 4040XP EDA
1 EA	KICKPLATE 8400 10 X 2 LDW
1 EA	WALLSTOP WS406/407CCV
1 SET	GASKETING PS074

GROUP 08

DR 215A, 232A, 232B

3 EA	BUTTS FBB179 4.5 X 4.5
1 EA	LOCKSET ND80R RHO
1 EA	ELECTRIC STRIKE 6211 (ONLY AT DOOR 232A)
1 EA	CLOSER 4040XP REGARM
1 EA	KICKPLATE 8400 10 X 2 LDW (NO KICKPLATE AT DOOR 215A)
1 EA	WALLSTOP WS406/407CCV
1 SET	GASKETING PS074

GROUP 09

DR 223A

3 EA	BUTTS FBB179 4.5 X 4.5
1 EA	LOCKSET ND80R RHO
1 EA	CLOSER 4040XP HEDA
1 EA	ARMOR PLATE 8400 30 X 2 LDW
1 SET	GASKETING PS074

GROUP 10

DR 227A, 228B

3 EA	BUTTS FBB179 4.5 X 4.5
1 EA	LOCKSET ND80R RHO
1 EA	ELECTRIC STRIKE 6211
1 EA	CLOSER 4040XP SCUSH
1 EA	KICKPLATE 8400 10 X 2 LDW
1 EA	WALLSTOP WS406/407CCV
1 SET	GASKETING PS074

GROUP 11

DRS 301A

3 EA	BUTTS FBB179 4.5 X 4.5
1 EA	EXIT DEVICE CD 99NL X 990NL
1 EA	RIM CYLINDER 20-057
1 EA	MORTISE CYLINDER 20-061 XQ11-948
1 EA	CLOSER 4040XP SCUSH
1 EA	KICKPLATE 8400 10 X 2 LDW
1 SET	GASKETING PS074

SECTION 088000
GLAZING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Glass for other sections referencing this Section.
 - 2. Exterior insulated glazing, Interior glazing, Interior safety glazing.
 - 3. Glazing compounds and accessories.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. American Architectural Manufacturers Association (AAMA) 800 - Voluntary Specifications and Test Methods for Sealants.
- B. American National Standards Institute (ANSI) Z97.1 - Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings.
- C. American Society of Civil Engineers (ASCE) 7 - Minimum Design Loads for Buildings and Other Structures.
- D. ASTM International (ASTM):
 - 1. C509 - Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
 - 2. C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants.
 - 3. C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
 - 4. C920 - Standard Specification for Elastomeric Joint Sealants.
 - 5. C1036 - Standard Specification for Flat Glass.
 - 6. C1048 - Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT, Coated and Uncoated Glass.
 - 7. C1115 - Standard Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.
 - 8. C1172 - Standard Specification for Laminated Architectural Flat Glass.
 - 9. C1281 - Standard Specification for Preformed Tape Sealants for Glazing Applications.
 - 10. C1294 - Standard Test Method for Compatibility of Insulating Glass Edge Sealants with Liquid-Applied Glazing Materials.
 - 11. C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
 - 12. E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.
 - 13. E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.
- E. Consumer Product Safety Commission (CPSC) 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.
- F. Glass Association of North America (GANA):
 - 1. Engineering Standards Manual.
 - 2. Glazing Manual.
 - 3. Laminated Glass Design Guide.
- G. National Fenestration Rating Council (NFRC):
 - 1. 100 - Procedure for Determining Fenestration Product Thermal Properties.
 - 2. 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficients at Normal Incidence.
 - 3. 300 - Procedures for Determining Solar Optical Properties of Simple Fenestration Products.
- H. Underwriters Laboratories (UL) 752 - Standard for Safety Bullet-Resisting Equipment.

1.3 SYSTEM DESCRIPTION

- A. Glass Thicknesses:
 - 1. Indicated thicknesses are minimums; select actual glass thicknesses by analyzing loads and conditions.
 - 2. Size glass to withstand positive and negative wind pressure acting normal to plane in accordance with Building Code as measured in accordance with ASTM E330.
 - 3. Provide glass in thicknesses and strengths to meet or exceed following criteria:
 - a. Comply with ASTM E1300.
 - b. Probability of breakage for vertical glazing: 8 lites per 1000 for lites set within 15 degrees of vertical and under wind load for load duration of 3 seconds.
 - c. Thickness of tinted glass: Provide same thickness for each tint color for all applications.

1.4 SUBMITTALS

- A. Submittals for Review:
 - 1. Product Data: Descriptive data and performance attributes for glass products.
 - 2. Samples:
 - a. 12 x 12 inch glass samples.
 - b. 1/4 x 1/4 x 3 inch long sealant and glazing compound samples in specified color.
 - 3. Warranty: Sample warranty form.
- B. Quality Control Submittals:
 - 1. Test Report: Preconstruction adhesion and compatibility test report from glazing sealant manufacturer, based on submitted samples or acceptable data from previous testing of current formulations with similar products.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 5 years documented experience in work of this Section.
- B. Regulatory Requirements:
 - 1. Provide safety glass for locations subject to human impact as required by Building Code.
 - 2. Safety glass: Tested and labeled to CPSC 16 CFR 1201.
- C. Perform Work in accordance with GANA Glazing Manual for glazing installation methods.
- D. Interior Glazing Sealers and Accessories: Maximum volatile organic compound (VOC) content as follows:
 - 1. Structural glazing sealant: 100 grams per liter.
 - 2. Glazing sealant: 250 grams per liter.
 - 3. Primers for non-porous substrates: 250 grams per liter.
 - 4. Primers for porous substrates: 775 grams per liter.

1.6 PROJECT CONDITIONS

- A. Perform glazing when ambient temperature is above 40 degrees F.
- B. Perform glazing on dry surfaces.

1.7 WARRANTIES

- A. Glass Coatings: Provide manufacturer's 10 year warranty against peeling, cracking, or deterioration of coating under normal conditions.
- B. Laminated Glass Units: Provide manufacturer's 5 year warranty against manufacturing defects resulting in edge separation, delamination, or material obstruction of vision through glass surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Glass:
 - 1. PPG Industries, Inc. (<http://www.ppg.com/>)
 - 2. Oldcastle Building Envelope. (www.oldcastlebe.com)
- B. Substitutions: Under provisions of Division 01.

2.2 GLAZING UNITS

- A. Type A - Sealed Insulating Glass Units: Vision glazing.
 - 1. Locations: All Exterior Glazing
 - 2. Application(s): All exterior glazing unless otherwise indicated.
 - 3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E type, PPG Solarban 70XL, on #2 surface.
 - 4. Inboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - 5. Total Thickness: 1 inch.
 - 6. Total Visible Light Transmittance: 64 percent, nominal.
 - 7. Total Solar Heat Gain Coefficient: 0.27 percent, nominal.
 - 8. Glazing Method: Gasket glazing.
- B. Type B - Interior Glazing:
 - 1. Locations: At interior storefront (not safety locations).
 - 2. Total thickness: 1/4 inch thick, minimum.
 - 3. Tint: Clear.
 - 4. Glazing Method: Gasket Glazing.
- C. Type C - Interior Safety Glazing:
 - 1. Locations: At interior door vision lites, interior storefront at safety locations.
 - 2. Total thickness: 1/4 inch thick, minimum.
 - 3. Tint: Clear.
 - 4. Interlayer: Polyvinyl butyral (PVB); meets ASTM C 1172
 - 5. Glazing Method: Gasket Glazing.

2.3 MATERIALS - GLASS

- A. Clear Glass: ASTM C1036, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select.
- B. Clear Tempered Glass: ASTM C1048, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select with horizontal tempering.
- C. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
 - 1. Laminated Safety Glass: Comply with 16 CFR 1201 test requirements for Category II.
 - 2. Plastic Interlayer: 0.030 inch thick, minimum.
 - a. Interlayer: Polyvinyl butyral of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.
 - 1) For polyvinyl butyral interlayers, laminate lites in autoclave with heat plus pressure.
 - b. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets.

3. Where fully tempered is specified or required, provide glass that has been tempered by the tong-less horizontal method.

2.4 SEALED INSULATING GLASS UNITS

- A. Sealed Insulating Glass Units: Types as indicated.
 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 2. Edge Spacers: Aluminum, bent and soldered corners.
 3. Edge Seal: Glass to elastomer with supplementary silicone sealant.
 4. Edge Seal Color: Black.
 5. Purge interpane space with dry hermetic air.

2.5 ACCESSORIES

- A. Setting Blocks: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone; 80 to 90 Shore A durometer hardness.
- B. Spacers: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone; 50 to 60 Shore A durometer hardness.
- C. Glazing Gaskets:
 1. Dense compression gaskets: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone or thermoplastic polyolefin rubber, molded or extruded shape to fit glazing channel retaining slot; black color.
 2. Soft compression gaskets: ASTM C509, Type II, black, molded or extruded, neoprene, EPDM, silicone or thermoplastic polyolefin rubber, of profile and hardness required to maintain watertight seal; black color.
- D. Butt Joint Glazing Sealant: ASTM C920, Type S, Grade NS, Class 25; single component silicone, low modulus type, non-sag, clear color.
- E. Glazing Sealant: ASTM C920, Type S, Grade NS, Class 25; single component silicone, low modulus, non-sag, clear color.
- F. Sealant Backing: ASTM C1330, Type O, size and density to control glazing sealant depth and produce optimum glazing sealant performance.
- G. Primer: As recommended by glazing sealant manufacturer.
- H. Glazing Tape: ASTM C1281 and AAMA 800; butyl based elastomeric tape with integral resilient tube spacer, 10 to 15 Shore A durometer hardness, black color, coiled on release paper; widths required for installation.

2.6 FABRICATION

- A. Annealed Glass: Comply with ASTM C1036.
- B. Tempered Glass:
 1. Comply with ASTM C1048.
 2. Process in horizontal position so that inherent roller distortion will run parallel to building floor lines after installation.
- C. Fabrication Tolerances: ASTM C1036 and ASTM C1048.
- D. Glass Identification:
 1. Apply manufacturer's label indicating type and thickness to each light of glass. Show position of exterior face when installed, where applicable.
 2. Etch manufacturer's label on each light of tempered glass.
- E. Source Quality Control:
 1. Preconstruction adhesion and compatibility testing:
 - a. Perform adhesion test including ultraviolet exposure through glass on production samples of metals and glass in accordance with ASTM C794.

- b. Test glass units, glazing materials, and glass framing members with specified finish for sealant compatibility, priming, and preparation requirements for optimum adhesion and performance.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean glazing rabbets; remove loose and foreign matter.
- B. Remove protective coatings on metal surfaces.
- C. Clean glass just prior to installation.

3.2 INSTALLATION - GENERAL

- A. Install glass in accordance with manufacturer's instructions.
- B. Maintain manufacturer's recommended edge and face clearances between glass and frame members.

3.3 INSTALLATION - GASKET GLAZING METHOD

- A. Fabricate gaskets to fit openings; allow for stretching of gaskets during installation.
- B. Set soft compression gasket against fixed stop or frame with bonded miter cut joints at corners.
- C. Set glass centered in openings on setting blocks.
- D. Install removable stops and insert dense compression gaskets at corners, working toward centers of glass, compressing glass against soft compression gaskets to produce weathertight seal.
- E. Seal joints in gaskets.
- F. Allow gaskets to protrude past face of glazing stops.

3.4 INSTALLATION - TAPE GLAZING METHOD

- A. Apply tape to permanent stops, projecting slightly above sight line.
- B. Press glass into contact with tape.
- C. Place glazing tape on removable stop side of glass.
- D. Install removable stop and apply pressure to ensure contact.
- E. Trim protruding tape edges.

3.5 PROTECTION

- A. After installation, mark glass with an 'X' using removable plastic tape.

END OF SECTION

**SECTION 092116
GYPSUM BOARD**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Gypsum board.
 - 2. Acoustical gypsum board.
 - 3. Taping and bedding of gypsum board.
 - 4. Resilient channels.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 079200 - Joint Sealers.

1.2 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. A108.11 - Interior Installation of Cementitious Backer Units.
 - 2. A118.9 - Test Methods and Specifications for Cementitious Backer Units.
- B. ASTM International (ASTM):
 - 1. C475 - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - 2. C514 - Standard Specification for Nails for the Application of Gypsum Wallboard.
 - 3. C665 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Wood Frame and Light Construction Buildings.
 - 4. C1002 - Standard Specification for Steel Drill Screws for the Application of Gypsum Board.
 - 5. C1047 - Standard Specifications for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - 6. C1178 - Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel.
 - 7. C1396 - Standard Specification for Gypsum Board.
 - 8. C1629 - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
 - 9. D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 - 10. E90 - Standard Test Method for Airborne Sound Transmission Loss of Building Partitions.
 - 11. E413 - Standard Test Method for Classification for Rating Sound Insulation.
- C. Gypsum Association (GA):
 - 1. GA-214 - Levels of Gypsum Board Finish.
 - 2. GA-216 - Recommended Specifications for the Application and Finishing of Gypsum Board.
 - 3. GA-600 - Fire Resistance Design Manual.
- D. Underwriters Laboratories, Inc. (UL) - Fire Resistance Directory.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Product Data: Illustrate panel product types, thicknesses, and locations; and accessories.
 - 2. Provide drawings identifying control joint locations.

1.4 QUALITY ASSURANCE

- A. Fire Resistance Ratings: Not Used.

1. Construct assemblies to achieve fire resistance ratings indicated on Drawings, in accordance with UL design number.
 2. If requirements of assembly numbers referenced conflict with Contract Document requirements, conform to assembly requirements.
- B. Acoustic Ratings: Construct assemblies to achieve acoustic ratings tested to ASTM E90 and classified in accordance with ASTM E413.

1.5 PROJECT CONDITIONS

- A. Do not install gypsum board until building is substantially weathertight.
- B. Maintain temperature in spaces in which work is being performed above 50 degrees F during and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers – Resilient Channel:
 1. Clark Dietrich (www.clarkdietrich.com)
 2. Auralex Acoustics (www.auralex.com)
- B. Acceptable Manufacturers - Gypsum Panels:
 1. CertainTeed Gypsum, Inc. (www.certainteed.com)
 2. GP Gypsum Corporation. (www.gp.com)
 3. National Gypsum Co. (www.nationalgypsum.com)
 4. USG Corporation. (www.usg.com)
- C. Acceptable Manufacturers – Acoustical Gypsum Panels:
 1. QuietRock, a PABCO Gypsum company (www.quietrock.com)
- D. Substitutions: Under provisions of Division 01.

2.2 MATERIALS - GYPSUM PANELS

- A. Fire-Resistant Gypsum Board: ASTM C1396; 48 inches wide x 5/8 inch thick, Type 'X' maximum practical length, tapered edge.
- B. Water Resistant Gypsum Board:
 1. ASTM C1396; 48 inches wide x 5/8 inch thick, maximum practical length, water resistant; apply to walls at janitor closets, toilet rooms, and kitchen.
 2. Mold resistance: 10, tested to ASTM D3273.
- C. Fire-Rated Acoustical Gypsum Board: ASTM E 119; 48 inches wide x 5/8" thick, Type X, for STC-rated assemblies 48-60; maximum practical length.

2.3 ACCESSORIES

- A. Fasteners: ASTM C1002, Type W & G screws, minimum 5/8 inch penetration into framing.
- B. Adhesive:
 1. Type recommended by gypsum panel manufacturer.
 2. Maximum volatile organic compound (VOC) content: 50 grams per liter.
- C. Trim Accessories: ASTM C1047.
 1. Material: Formed steel, minimum 26 gage core steel, hot dip galvanized finish, expanded flanges.
 2. Corner reinforcement: GA-216, Type CB-100 x 100.
 3. Casing: GA-216, Type LC.
 4. Control joint.
- D. Joint Treatment Materials:
 1. Reinforcing tape and joint compound; ASTM C475.

2. Joint compound; maximum volatile organic compound (VOC) content: 250 grams per liter.
- E. Acoustical Sealer: Specified in Section 079200.

PART 3 EXECUTION

3.1 INSTALLATION OF GYPSUM PANELS

- A. Install panels and accessories in accordance with ASTM C754, GA-216, and manufacturer's instructions.
- B. Accurately cut panels to fit around openings and projections. Do not tear face paper or break gypsum core.
- C. Apply panels at non-fire-rated assemblies in most economical manner, with ends and edges occurring over supports.
- D. Apply panels at fire-rated assemblies as required by design assembly.
- E. Stagger joints on opposite sides of partitions.
- F. Do not locate joints to align with edges of openings unless a control joint is installed.
- G. Mechanically fasten panels to framing. Place fasteners minimum 3/8 inch from edges of panels; drive heads slightly below surface. Stagger fasteners at abutting edges.
- H. Apply face layer of double layer applications with joints offset from those in base layer; secure with mechanical fasteners to framing or with adhesive to base layer.
- I. At deflection compensating head tracks, cut panels 1/2 inch short of structure at head; do not secure panels to top runner channel.
- J. Treat cut edges and holes in moisture resistant gypsum board with joint sealer.
- K. Where recessed items occur in fire rated partitions, box item on all sides with gypsum board as required to maintain continuity of fire rating.

3.2 INSTALLATION OF ACOUSTICAL PARTITIONS

- A. Follow acoustical gypsum board manufacturer's instructions for installation of panels, sealant and putty pads.
- B. Extend acoustical partitions past intersecting non-acoustical partitions.
- C. Install putty pads at all boxes located within acoustic walls.
- D. Install acoustical insulation:
 1. Butt to framing members and adjacent construction.
 2. Carry around pipes, wiring, outlets, and other construction without voids.
 3. Press against one gypsum board surface to form slight air space on opposite side.
- E. Seal acoustical partitions at perimeter and around penetrations:
 1. Apply continuous bead of sealer between gypsum panel edges and adjacent construction.
 2. Seal space between gypsum panels at control joints, prior to installing metal control joint.
 3. Apply sealer to penetrations through partitions.

3.3 INSTALLATION OF ACCESSORIES

- A. Install in accordance with manufacturer's instructions.
- B. Install corner reinforcement at outside corners. Use single lengths where length of corner does not exceed standard length.
- C. Install casings where indicated and where gypsum board abuts dissimilar materials or stops with edge exposed.
- D. Install control joints at ceilings:
 1. At maximum 50 feet on center.
 2. Where ceiling framing changes direction.
- E. Install control joints at walls and partitions:
 1. At changes in backup material.

2. At maximum 30 feet on center.
3. Above both jambs of openings in partitions.

3.4 JOINT TREATMENT

- A. Treat joints and fasteners in gypsum board in accordance with GA-214.

3.5 LEVELS OF FINISH

1. Surfaces to receive eggshell paints / wall coverings: Level 4 finish.
2. Surfaces to receive semigloss paints: Level 4 finish.

END OF SECTION

SECTION 092300
GYPSUM PLASTERING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Gypsum plaster over concrete substrate.
 - 2. Trim.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 018113 – Sustainable Design Requirements.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. C28 - Standard Specification for Gypsum Plaster.
 - 2. C588 - Standard Specification for Gypsum Base for Veneer Plasters.
 - 3. C631 - Standard Specification for Bonding Compounds for Interior Plastering.
 - 4. C842 - Standard Practice for Application of Interior Plaster.
 - 5. C844 - Standard Practice for Application of Gypsum Base to Receive Gypsum Veneer Plaster.
 - 6. C847 - Standard Specification for Metal Lath.
- B. Gypsum Association (GA) 201 - Using Gypsum Board for Walls and Ceilings.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Product Data: Manufacturer's descriptive data and application instructions.
 - 2. Samples: 12 x 12 inch sample showing finish coat in proposed texture.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Minimum 5 years documented experience in work of this Section.

1.5 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Do not apply plaster when ambient or substrate temperature is less than 50 degrees F nor more than 85 degrees F.
 - 2. Maintain minimum ambient temperature of 50 degrees F during and after application of plaster.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. GP Gypsum Division (www.gp.com) .
 - 2. National Gypsum Co. (www.nationalgypsum.com)
 - 3. USG Corporation. (www.usg.com)
- B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Plaster Base Material:
 - 1. ASTM C28, gypsum mill aggregated type; Gold Bond Two-Way Hardwall Gypsum Plaster by National Gypsum or accepted substitute.
- B. Finishing Plaster:
 - 1. ASTM C28, mixture of gauging plaster and lime; Gold Bond Gypsum Gauging Plaster by National Gypsum or accepted substitute.

2.3 ACCESSORIES

- A. Trim Accessories:
 - 1. Material: Formed steel, minimum 26 gage core steel, hot dip galvanized finish, expanded flanges.
 - 2. Corner bead: Beaded edge, of longest practical length, size and profile to suit application.
 - 3. Casing bead: Thickness governed by plaster thickness, of longest practical length, square edge.
 - 4. Corner reinforcement: Shaped to permit complete embedment in plaster, minimum 2 inches wide.
- B. Fasteners: Type and size suited to application, galvanized.
- C. Tie Wire: 16 gage, galvanized steel, soft annealed.
- D. Bonding Agent: ASTM C631; type recommended for bonding plaster directly to concrete surfaces.
- E. Water: Potable.

2.4 MIXES

- A. In accordance with manufacturer's instructions.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean substrate surfaces of foreign matter.
- B. Dampen surfaces to prevent excessive suction.
- C. Apply bonding agent in accordance with manufacturer's instructions.

3.2 INSTALLATION OF ACCESSORIES

- A. Install casing beads where plaster abuts dissimilar material or stops with edge exposed.
- B. Install corner beads at external corners.
- C. Set level and true to line.

3.3 APPLICATION OF PLASTER

- A. Apply plaster in accordance with ASTM C842 and manufacturer's instructions.
- B. Apply 3/8 inch thickness scratch coat and 3/8 inch thickness brown coat.
- C. Apply finish coat to minimum 1/8 inch thickness. Finish to flat, smooth, hard troweled surface.

- D. Finish surfaces with neat, sharp corners and intersections.
- E. Perform work in panels to nearest natural break formed by intersections, corners, trim, and accessories.
- F. Installation Tolerance: Surfaces true to 1/8 inch in 10 feet.

3.4 ADJUSTING

- A. Repair or replace damaged, discolored and defective plaster. Match patched areas to surrounding plaster.

END OF SECTION

SECTION 093013

CERAMIC TILING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ceramic and Porcelain tile floor and wall tile.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 018113 – Sustainable Design Requirements.
 - 3. Section 079200 - Joint Sealers.

1.2 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. A108/A118/A136.1 - American National Standard for Installation of Ceramic Tile.
 - 2. A137.1 - Specifications for Ceramic Tile.
- B. ASTM International (ASTM):
 - 1. A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - 2. A185/A185M - Standard Specification for Welded Steel Wire Reinforcement, Plain, for Concrete.
 - 3. C144 - Standard Specification for Aggregate for Masonry Mortar.
 - 4. C150 - Standard Specification for Portland Cement.
 - 5. C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - 6. C847 - Standard Specification for Metal Lath.
 - 7. D226 - Standard Specification for Asphalt Saturated Organic Felt Used in Roofing and Waterproofing.
 - 8. D227 - Standard Specification for Coal-Tar Saturated Organic Felt Used in Roofing and Waterproofing.
 - 9. D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 - 10. D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications.
- C. Tile Council of North America (TCNA) - Handbook for Ceramic, Glass and Stone Tile Installation.
- D. Resilient Floor Covering Institute (RFCI) - FloorScore Certification Program.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate installation of openings thorough floor slabs, partition locations, adjacent wall substrates, waterproofing, drain assembly, drain pipes, shower curtain, and rod, and finish surfaces.

1.4 SUBMITTALS

- A. Submittals for Review:
 - 1. Product Data: Manufacturer's installation, cleaning, and maintenance instructions.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 5 years experience in work of this Section.

- B. Tile and Trim Units: Meet ANSI A137.1, Standard
- C. Dynamic Static Coefficient of Friction for Floor Tile: Minimum 0.42, tested in accordance with ANSI A137.1 using BOT-3000 tribometer.
- D. Mockup:
 - 1. Size: 4 x 8 feet.
 - 2. Show: Tile colors and patterns, joint profile, and control joint.
 - 3. Locate where directed.
 - 4. Approved mockup may remain as part of the Work.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver mortar, adhesive, and grout containers bearing hallmark certifying compliance with reference standards.
- B. Protect adhesive containers from freezing and overheating according to manufacturer's instructions.
- C. Store products in manufacturer's unopened packaging until ready for installation.
- D. Store materials in a dry, warm, ventilated weather tight location.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements: Maintain minimum ambient temperature of 50 degrees F during and after installation.

1.8 MAINTENANCE

- A. Extra Materials: One unopened carton of each tile.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Tile:
 - 1. Daltile (www.daltile.com)
- B. Acceptable Manufacturers - Setting and Grouting Materials:
 - 1. BASF Corporation. (www.buildingsystems.basf.com)
 - 2. Bostik, Inc. (www.bostik-us.com)
 - 3. Laticrete International, Inc. (www.laticrete.com)
 - 4. Mapei Corporation. (www.mapei.us)
 - 5. TEC. (www.tecspecialty.com)
- C. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Floor Tile:
 - 1. Size: 12 x 12 (11-7/8 x 11-7/8 inches actual) x 5/16 inch thick.
 - 2. Edge: Rectified
 - 3. Color: Where tile exhibits natural color variations, blend tile on site to provide uniform color variations between cartons.
 - 4. Surface finish: Glazed with Stepwise Technology
 - 5. Wet Dynamic Coefficient of Friction Range: 0.42.
 - 6. Basis of Design: Daltile – Volume 1.0 – 12 x 12 Reverb Ash VL74.

- B. Restroom Wall Tile:
 - 1. Size: 3 x 6 (3 x 6 inches actual) x 5/16 inch thick.
 - 2. Edge: Rectified.
 - 3. Color: Where tile exhibits natural color variations, blend tile on site to provide uniform color variations between cartons.
 - 4. Surface finish: Matte
 - 5. Basis of Design: Daltile Color Wheel Classic - Matte Architectural Gray K0709 3 x 6.
- C. Existing Restroom Wall Tile:
 - 1. Size: 4 x 4 (4-1/4 x 4-1/4 inches actual) x 5/16 inch thick.
 - 2. Edge: Rectified.
 - 3. Color: Where tile exhibits natural color variations, blend tile on site to provide uniform color variations between cartons.
 - 4. Surface finish: Matte
 - 5. Basis of Design: Daltile Color Wheel Classic – Color to be selected.

2.3 ACCESSORIES

- A. Latex-Portland Cement Mortar: ANSI A118.4, polymer modified dry set type.
- B. Dry Set Portland Cement Mortar: ANSI A118.1, polymer modified dry set type.
- C. Epoxy Adhesive:
 - 1. ANSI A118.3, thin set bond type.
- D. Portland Cement: ASTM C150, Type 1, white color.
- E. Sand: ASTM C144, clean, free of organic matter.
- F. Lime: ASTM C207, Type S, hydrated.
- G. Water: Clean, potable.
- H. Grout:
 - 1. ANSI A118.6, polymer modified type, unsanded. A118.3, epoxy type.
 - 2. Color: To be selected from manufacturer's full color range.
- I. Thresholds: ADA compliant.
- J. Joint Sealers: Specified in Section 079200.
- K. Waterproof Membrane:
 - 1. Type: Load bearing, with reinforcing fabric.
- L. Joint Tape: Waterproof, perforated bedding tape.
- M. Cleavage Membrane: ASTM D4397, 6 mil thick black polyethylene film; ASTM D226, No. 15 non-perforated asphalt saturated felt; or ASTM D227, No. 15 non-perforated coal tar saturated felt.
- N. Reinforcing: ASTM A82/A82M or ASTM A185/A185M, 2 x 2, 16 gage, welded wire mesh, hot dip galvanized.
- O. Metal Lath: ASTM C847, expanded diamond mesh, hot dip galvanized.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean surfaces to remove loose and foreign matter that could impair adhesion.

- B. Remove ridges and projections. Fill voids and depressions with patching compound compatible with setting materials.
- C. Allowable Substrate Tolerances:
 - 1. Thin set method:
 - a. Maximum variation in substrate surface: 1/8 inch in 8 feet.
 - b. Maximum height of abrupt irregularities: 1/32 inch.
 - 2. Thick set method: Maximum 1/4 inch in 10 feet variation in substrate surface.
- D. Test concrete substrate to ASTM D4263; do not install tile until surfaces are sufficiently dry.

3.2 INSTALLATION

- A. Install crack suppression membrane, waterproof membrane in accordance with manufacturer's instructions.
- B. Methods:
 - 1. Walls: ANSI A108.5, thin set with latex-portland cement mortar over cement board over metal studs.
 - 2. Floors: ANSI A118.5, thin set with latex-portland cement mortar over concrete.
- C. Minimize pieces less than one half size. Locate cuts to be inconspicuous.
- D. Lay tile to pattern furnished by Architect. Do not interrupt tile pattern through openings.
- E. Joint Width: 3/16 inch.
- F. Make joints watertight, without voids, cracks, excess mortar, or excess grout. Align joints in wall and floor of same-sized tile.
- G. Fit tile around projections and at perimeter. Smooth and clean cut edges. Ensure that trim will completely cover cut edges.
- H. Control Joints:
 - 1. Provide control joints at:
 - a. Changes in backup material.
 - b. Changes in plane.
 - c. Over joints in substrate.
 - d. Maximum 24 feet on center at interior locations except maximum 8 feet at surfaces exposed to direct sunlight.
 - 2. Form joints per TCNA Method EJ-171.
 - 3. Install joint backing and joint sealer as specified in Section 079200.

3.3 ADJUSTING

- A. Remove and replace pieces that have been damaged during installation.

3.4 PROTECTION

- A. Provide protection for completed work using non-staining sheet coverings.
- B. Prohibit traffic on tile floors for minimum 3 days after installation.

END OF SECTION

SECTION 095113
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Suspended metal ceiling grid system.
 - 2. Acoustical ceiling panels.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. A641 - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - 2. C635 - Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
 - 3. C636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - 4. E580 - Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint.
 - 5. E1264 - Standard Classification of Acoustical Ceiling Products.
- B. Ceiling and Interior Systems Construction Association (CISCA) - Ceiling Systems Handbook.
- C. Underwriters Laboratories, Inc. (UL) - Fire Resistance Directory.
- D. Northwest Wall & Ceiling Bureau: Technical Document 401 - Suspension Systems for Acoustical Lay-in Ceilings Seismic Design Categories D, E & F (included at end of this document).

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Samples:
 - a. 6 x 6 inch acoustical panel samples.
 - b. 12 inch long suspension system samples showing each profile.
- B. Quality Control Submittals:
 - 1. Certificates of Compliance: Certification from an independent testing laboratory that acoustical panels meet fire hazard classification requirements.
- C. Sustainable Design Submittals:
 - 1. Recycled Content.
 - 2. Regional Materials.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 5 years documented experience in work of this Section.
- B. Installed System: Conform to UL Roof/Ceiling Design No. 265.
- C. Fire Hazard Classification: Class A rated, tested to ASTM E1264.

1.5 PROJECT CONDITIONS

- A. Environmental Requirements: Install in approximately same conditions of temperature and humidity as will prevail after installation.

1.6 MAINTENANCE

- A. Extra Materials: One unopened carton of each acoustical panel type.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Acoustical Units:
 - 1. Armstrong World Industries, Inc. (www.armstrong.com)
 - 2. Chicago Metallic Corporation. (www.chicago-metallic.com)
 - 3. USG Corporation. (www.usg.com)
- B. Acceptable Manufacturers - Suspension System:
 - 1. Armstrong World Industries, Inc. (www.armstrong.com)
 - 2. Certainteed Corporation (www.certainteed.com)
 - 3. USG Corporation. (www.usg.com)
- C. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Suspension Grid System:
 - 1. Basis of Design: Prelude XL 15/16" by Armstrong and Prelude XL Fire Guard 15/16" or approved substitute.
 - 2. ASTM C635, heavy duty, die cut, interlocking ends.
 - 3. Grid type: Exposed T.
 - 4. Material: Galvanized steel.
 - 5. Exposed Grid Surface Width: 15/16".
 - 6. Perimeter molding: Angle shape.
 - 7. Finish: Factory applied polyester paint, sprayed and baked, white color to match acoustical panels.
 - 8. Accessories: Stabilizer bars, clips, and splices.
 - 9. Recycled content: Minimum 60 percent.
- B. Acoustical Panels:
 - 1. ACT-1 (General): Basis of Design: Cortega Second Look II by Armstrong or approved substitute.
 - 2. ACT-2 (Men's and Women's RRs): Basis of Design: Armstrong KitchenZone
 - 3. Size: 24 x 24 inches x ¾ inch thick.
 - 4. Scoring: creates nominal 24" x 24" squares.
 - 5. Edge configuration: Angled Tegalur.
 - 6. Performance requirements: Tested in accordance with ASTM E1264.
 - a. NRC: 0.55.
 - b. CAC: 35.
 - c. Light reflectance: LR-0.82.
 - d. Fire Rating: Class A and Fire Guard (verify locations).
 - 7. Recycled content: Minimum 30% percent.

2.3 ACCESSORIES

- A. Support Channels:
 - 1. Galvanized steel; size and type to suit application.
- B. Hanger Wire:
 - 1. ASTM A641, minimum 12 gage galvanized steel.
- C. Hold Down Clips: Minimum 24 gage spring steel, manufacturer's standard profile.
- D. Impact Clips: Minimum 24 gage spring steel, manufacturer's standard profile.
- E. Touch-Up Paint: Color to match acoustical panels and suspension grid.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install ceilings in accordance with ASTM C636 and CISCA Handbook.
- B. Minimize panels less than one half size.
- C. Install molding around perimeters and abutting surfaces. Miter molding at exterior corners; cut flanges and bend web to form interior corners.
- D. Space hanger wires maximum 48 inches on center. Install additional hangers where required to support light fixtures and ceiling supported equipment.
- E. Do not suspend hangers directly from metal deck. Attach steel channel horizontally to adjacent framing members; place hanger at regular spacing.
- F. Hang suspension system independent of walls, columns, ducts, pipes, and conduit.
- G. Where ducts or other equipment prevent regular spacing of hangers:
 - 1. Reinforce nearest related hangers to span extra distance, or:
 - 2. Suspend steel channel horizontally beneath duct or equipment; place hanger at regular spacing.
- H. Install main tees at maximum 48 inches on center.
- I. Install cross tees to form 24 x 48 inch modules. Lock cross tees to main tees.
- J. Support ends of tees on flange of perimeter molding.
- K. Place acoustical panels with edges resting flat on suspension grid.
- L. Cutting Acoustic Units:
 - 1. Cut to fit irregular grid and perimeter edge trim and around penetrations.
 - 2. Locate cuts to be concealed.
 - 3. Cut and field paint exposed edges of reveal edge units to match factory edge.
- M. Place hold down clips over cross tees at mid-point of each module.
- N. Place impact clips over cross tees at mid-point of each module.
- O. Installation Tolerances: Ceilings level to 1/8 inch in 12 feet measured in any direction.

3.2 ADJUSTING

- A. Touch up minor scratches and abrasions to match factory finish.

END OF SECTION

SECTION 095426
SUSPENDED WOOD CEILINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

- A. Section Includes
 - 1. Suspended Wood ceiling panels (Linear Grid)
 - 2. Wood perimeter trim
 - 3. Exposed grid suspension system
 - 4. Wire hangers, fasteners, main runners, wall angle moldings and accessories.
- B. Related Sections:
 - 1. Section 09 51 13 - Acoustical Ceiling Suspension Assemblies
 - 2. Section 09 21 16 - Gypsum Board
 - 3. Division 23 - HVAC
 - 4. Division 26 - Electrical

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1) ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
 - 2) ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 - 3) ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
 - 4) ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - 5) ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
 - 6) ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
 - 7) ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
 - 8) ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
 - 9) ASTM E 1264 Classification for Acoustical Ceiling Products
- B. Hardwood Plywood & Veneer Association (HPVA)
- C. International Building Code
- D. ASHRAE Standard 62.1-2004 Ventilation for Acceptable Indoor Air Quality
- E. NFPA 70 National Electrical Code
- F. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
- G. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
- H. International Code Council-Evaluation Services Report - Seismic Engineer Report
 - 1. ESR 1308 - Armstrong T-Bar or Dimensional Suspension.
- I. California Air Resources Board (CARB) compliant.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each type of ceiling unit and suspension system required.
- B. Installation Instructions: Submit manufacturer's installation instructions as referenced in Part 3, Installation.
- C. Samples: Minimum 3-1/2 inch or 5-1/2 inch samples of specified panel; 8 inch long samples of exposed wall molding and suspension system, including main runner.
- D. Shop Drawings: Illustrating the layout and details of the ceilings. Show locations of items that are to be coordinated with, or supported by the ceilings.
- E. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.
- F. All products not conforming to manufacturer's current published values must be removed and dispose. Replace with complying product at the expense of the Contractor performing the work.

1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide ceiling panel units and grid components by a single manufacturer.
- B. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.
 - 1. Surface Burning Characteristics: As follows, tested by HPVA (Hardwood Plywood and Veneer Association) under the test standard ASTM E-84 tunnel test and complying with ASTM E 1264 for Class A products.
 - a. Flame Spread: 25 or less
 - b. Smoke Developed: 50 or less
- C. Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.
- D. Woodworks Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.
- E. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, wet work i.e. gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store the wood veneer ceiling panels in a dry interior location in their cartons prior to installation to avoid damage. Store the ceiling panel cartons in a flat, horizontal position. Do not remove the protectors between the panels until installation.
- B. Do not store in unconditioned spaces with humidity greater than 55 percent or lower than 25 percent relative humidity and temperatures lower than 50 degrees F or greater than 86 degrees F. Do not expose the wood veneer ceiling panels to extreme temperatures, for example, close to a heating source or near a window with direct sunlight.
- C. Handle ceiling units carefully to avoid chipped edges or damage to units in any way.

1.7 PROJECT CONDITIONS

- A. Prior to installation, the wood ceiling materials are required to reach room temperature and have stabilized moisture content for a minimum of 72 hours.
- B. Do not install the wood panels in spaces where the temperature or humidity conditions vary greatly from the temperatures and conditions that will be normal in the occupied space.
- C. As interior finish products, the wood panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

1.8 WARRANTY

- A. Wood Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to:
 - 1. Ceiling Panels (Linear Grid): Defects in materials or factory workmanship
 - 2. Grid System: Rusting and manufacturing defects
- B. Warranty Period:
 - 1. Wood Panels (Linear Grid): One (1) year from date of installation
 - 2. Grid: One (1) year from date of installation
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.9 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - 1. Ceiling Units: Furnish quantity of full-size units equal to 5.0 percent of amount installed.
 - 2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Ceiling Panels:
 - 1. Armstrong World Industries, Inc.
 - 2. Madrid Inc.
 - 3. 9wood
 - 4. Saint-Gobain, Decoustics
- B. Suspension Systems:
 - 1. Armstrong World Industries, Inc.
 - 2. Certainteed Corporation

2.2 WOOD LINEAR CEILING UNITS

- A. Linear Ceiling Panels:
 - 1. Basis-of-Design: WOODWORKS Grille, Item # 7264BO as manufactured by Armstrong World Industries
 - 2. Slat Height: 1 3/8"
 - 3. Composition: Wood
 - 4. Species/Finish: to be determined.
 - 5. Panel Size: 12 in x 96 in

6. Reveal: Backer Only
 7. Edge Banding and Wood Trim: to match wood species.
 8. Noise Reduction Coefficient (NRC): ASTM C 423, Classified with UL label on product carton 0.75
 9. Flame Spread: ASTM E84 HPVA Fire Classification (Fire Class)
 10. Surface Texture: Smooth
- B. Ceiling Accessories (Ceilings) WoodWorks:
1. Backer Clips

2.3 METAL SUSPENSION SYSTEMS

- A. Components: Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction with type exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
 1. Structural Classification: ASTM C 635 Heavy Duty duty
 2. Color: Black.
 3. Basis-of-Design: PRELUDE XL 15/16" Exposed Tee as manufactured by Armstrong World Industries
- B. Attachment Devices:
Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- C. Wire for Hangers and Ties:
ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least three times design load, but not less than 12 gauge.
- D. Wood Works Edge Trim:
 1. 5660W1NMP – 6" x 120" Wood Trim, to match wood species.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out.
- B. Proper designs for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

- A. Install suspension system and panels in compliance with ASTM C636; CISCA Seismic Guidelines; approved construction drawings; with the authorities having jurisdiction; and in accordance with the manufacturer's installation instructions.

3.4 ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.

- B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096513
RESILIENT BASE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient wall base.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. ASTM International (ASTM) F1861 - Standard Specification for Resilient Wall Base.
- B. Resilient Floor Covering Institute (RFCI) - FloorScore Certification Program.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Samples: 4 inch long samples in each color specified.
- B. Sustainable Design Submittals:
 - 1. Recycled Content.
 - 2. Regional Materials.
 - 3. Low-VOC Emitting Materials.

1.4 MAINTENANCE

- A. Extra Materials: 25 linear feet of each profile and color.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Roppe Corp. (www.roppe.com)
 - 2. Johnsonite, Inc. (www.johnsonite.com)
 - 3. Armstrong World Industries. (www.armstrong.com)
 - 4. Burke Flooring. (www.burkeflooring.com)
- B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Resilient Base:
 - 1. Type: ASTM F1861, thermoset vulcanized rubber.
 - 2. Thickness: 0.125 inch.
 - 3. Profile: Coved.
 - 4. Height: 4 inches. See Finish Schedule for locations.
 - 5. Length: 120 foot rolls.
 - 6. Color: To be selected from manufacturer's full color range.
 - 7. Finish: Satin.
 - 8. End units: Preformed; profile, size, and color to match base.
 - 9. Certified under RFCI FloorScore Certification Program.

2.3 ACCESSORIES

- A. Adhesive:
 - 1. Water based, waterproof, recommended by base manufacturer.
 - 2. Maximum volatile organic compound (VOC) content: 50 grams per liter.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prepare surfaces to receive base:
 - 1. Remove materials that could interfere with adhesion.
 - 2. Fill low spots with patching compound; finish flush with adjacent surface.
 - 3. Remove high spots, ridges and nibs.

3.2 INSTALLATION

- A. Apply adhesive continuously to back of base.
- B. Maintain top edge true to line and bottom edge in continuous contact with floor. Butt joints tight; butt base tight to adjacent construction.
- C. Base to run from building corner to building corner, unless interrupted by opening or cabinetry. Do not install multiple pieces on same wall.
- D. Miter and butt inside corners.
- E. At outside corners "V" cut back of base to 2/3 of its thickness and bend around corner.
- F. At exposed ends, install pre-molded units.
- G. Scribe to door frames and other interruptions.

END OF SECTION

SECTION 096516
RESILIENT FLOORING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Vinyl composition tile flooring
 - 2. Rubber tile flooring
 - 3. Rubber stair treads with riser and stringers
- B. Related Sections:
 - 1. Section 092116 - Gypsum Wallboard: Wall substrate to receive base.

1.2 REFERENCES

- A. American Society for Testing and Materials:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
 - 3. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
 - 4. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile.
- B. National Fire Protection Association:
 - 1. NFPA 253 - Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate seaming plan, custom patterns and inlay designs.
- C. Product Data: Submit data describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- D. Samples:
 - 1. Submit duplicate sets of manufacturer's complete set of color samples for initial selection.

1.4 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Protect roll materials from damage by storing on end.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 016000 - Product Requirements.
- B. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- C. Store materials for not less than 48 hours prior to installation in area of installation at temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.8 EXTRA MATERIALS

- A. Section 017000 - Execution Requirements: Spare parts and maintenance products.
- B. Furnish one full box of field color for each flooring material type.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Manufacturers:
 - 1. Armstrong World Industries. www.armstrongfloors.com
 - 2. Roppe Corp. www.roppe.com
 - 3. Substitutions: Section 016000 - Product Requirements.
- B. Components:
 - 1. VCT Armstrong Vinyl Composition Tile, Premium Excelon Crown Texture
 - a. Size: 12" x12".
 - b. Thickness: 1/8 inch.
 - c. Colors: See finish Legend on drawings.
 - 2. RT Roppe Rubber Tile Raised Design, 994 Raised Square
 - a. Size: 19-11/16" x 19-11/16".
 - b. Thickness: 1/8 inch.
 - c. Color: see finish legend on drawings.
 - 3. RST Roppe Rubber Stair Tread with Riser, Stringers
 - a. Tread Pattern: raised square #94
 - b. Tread Depth: 12-5/16".
 - c. Tread Thickness: 1/4 inch.
 - d. Stringer size: 12" x 72"
 - e. Stringer thickness: .080"
 - d. Color: see finish legend on drawings.

2.2 ACCESSORIES

- A. Subfloor Filler: Premix latex; type recommended by adhesive material manufacturer.
- B. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.
- C. Moldings and Edge Strips: Pre-molded rubber trim manufactured by Armstrong or approved. Type and color as selected.
- D. Feature Strips: Of same material as flooring, as detailed
- F. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013100 - Project Management and Coordination: Verification of existing conditions before starting Work.
- B. Verify concrete floors are dry to maximum moisture content as recommended by manufacturer, and exhibit negative alkalinity, carbonization, and dusting.
- C. Verify floor and lower wall surfaces are free of substances capable of impairing adhesion of new adhesive and finish materials.

3.2 PREPARATION

- A. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- B. Prohibit traffic until filler is cured.
- C. Clean substrate.
- D. Apply primer as required to prevent "bleed-thru" or interference with adhesion by substances which cannot be removed.

3.3 INSTALLATION - VINYL COMPOSITION TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed.
- B. Lay flooring with joints and seams parallel to building lines to produce approved tile pattern.
- C. Install tile to patterns shown. Allow minimum ½ full size tile width at room or area perimeter.
- D. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- E. Where floor finishes are different on opposite sides of door, terminate flooring under centerline of door.
- F. Install rubber edge strips at unprotected or exposed edges, where flooring terminates, and where indicated. Secure rubber strips before installation of flooring with adhesive.
- G. At movable partitions, install flooring under partitions without interrupting floor pattern.
- H. Install feature strips and floor markings where indicated. Fit joints tightly.

3.4 CLEANING

- A. Section 017000 - Execution Requirements: Final cleaning.
- B. Remove excess adhesive from floor, base, and wall surfaces without damage.
- C. Clean and maintain resilient flooring products. Sealing and waxing will be by SOU.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 017000 - Execution Requirements: Protecting installed construction.
- B. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 096813

TILE CARPETING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Tile carpeting.
 - 2. Edgings.
- B. Related Sections:
 - 1. Division 01 - Administrative, procedural, and temporary work requirements.
 - 2. Section 096513 - Resilient Base.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. D2859 - Standard Test Method for Flammability of Finished Textile Floor Covering Materials.
 - 2. D4258 - Standard Practice for Surface Cleaning Concrete for Coating.
 - 3. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 4. E648 - Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
 - 5. E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
 - 6. F710 - Standard Practice for Preparing Concrete to Receive Resilient Flooring.
 - 7. F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - 8. F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- B. Carpet and Rug Institute (CRI):
 - 1. 104 - Standard for Installation Specification of Commercial Carpet.
 - 2. Indoor Air Quality Testing Program.
- C. National Fire Protection Association (NFPA) 253 - Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Shop Drawings: Indicate carpet tile locations, dye lot limitations, direction of carpet tile in each room or area, and type and location of edgings.
 - 2. Samples:
 - a. Carpet tile: Full size samples of each color.
 - 3. Warranty: Sample warranty form.
- B. Quality Control Submittals:
 - 1. Certificates of Compliance: Certification from an independent testing laboratory that carpet tiles meet fire hazard classification requirements.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 10 years documented experience in work of this Section.
- B. Fire Hazard Classification: Pass flammability requirements of ASTM D2859.

1.5 PROJECT CONDITIONS

- A. Do not begin installation until painting and finishing work have been completed.

- B. Environmental Requirements:
 - 1. Temperature of spaces and subfloor between 65 and 90 degrees F.
 - 2. Humidity in spaces to receive carpet tiles between 20 and 65 percent.

1.6 WARRANTIES

- A. Furnish manufacturer's 15 year warranty providing coverage against:
 - 1. Defective materials and workmanship.
 - 2. Excessive fading.
 - 3. Loss of static control.
 - 4. Edge raveling.
 - 5. Runs.
 - 6. Loss of tuft bind strength.
 - 7. Loss of face fiber.
 - 8. Excessive wear.

1.7 MAINTENANCE

- A. Extra Materials: 4 unopened cartons of each tile type.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Carpet Tiles:
 - 1. Patcraft
- B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Carpet Tile 1 (CPT-1):
 - 1. Source: Patcraft Organic Interruption, Underlie Collection, 00680 Rust.
 - 2. Construction: Multi-level Pattern Loop.
 - 3. Fiber: Solution Q Extreme Nylon.
 - 4. Dye Method: 100% Solution Dyed.
 - 5. Backing: EcoWorx Tile.
 - 6. Protective Treatment: SSP Shaw Soil Protection.
 - 7. Size: 24" x 24"
 - 8. Gauge: 1/10
 - 9. Stitches: 10 per inches
 - 10. Finished Pile Thickness: .099
 - 11. Average Density: 5818
 - 12. Total Thickness: 0.224
 - 13. Tufted Weight: 16.0 oz
 - 14. Color: To be selected by Architect from full range of colors within collection.
- B. Carpet Tile 2 (CPT-2):
 - 1. Source: Patcraft Learning Lab Collection, 00700 Interaction.
 - 2. Construction: Multi-level Pattern Loop.
 - 3. Fiber: EcoSolution Q100 Nylon.
 - 4. Dye Method: 100% Solution Dyed.
 - 5. Backing: EcoWorx Tile.
 - 6. Protective Treatment: SSP Shaw Soil Protection.
 - 7. Size: 24" x 24"

8. Gauge: 1/10
9. Stitches: 10 per inches
10. Finished Pile Thickness: .099
11. Average Density: 5818
12. Total Thickness: 0.224
13. Tufted Weight: 16.0 oz
14. Color: To be selected by Architect from full range of colors within collection.

2.3 ACCESSORIES

- A. Primer: XL Brands TriSeal or similar product approved by carpet manufacturer.
- B. Tile Connectors: Per manufacturers recommendation.
- C. Edgings: Preformed rubber or approved substitute, profile required to suit conditions, color to be selected from manufacturer's full color range.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean substrate; remove loose and foreign matter that could impede adhesion or performance of flooring.
- B. Repair loose or broken boards. Secure with 8D cement-coated screw nails
- C. Fill cracks, voids, and depressions with patching compound approved by carpet manufacturer.
- D. Sand ridges and high spots smooth.
- E. Test Substrate:
 1. Moisture vapor: Test to ASTM F1869; do not install carpet tiles until moisture emission level is acceptable to carpet tile manufacturer.
 2. Humidity: Test to ASTM F2170; do not install carpet tiles until relative humidity is acceptable to carpet tile manufacturer.
 3. Alkalinity: Test to ASTM F710; do not install carpet tiles unless pH is acceptable to carpet tile manufacturer.

3.2 INSTALLATION OF CARPET TILES

- A. Install in accordance with CRI 104.
- B. Install carpet tile in accordance with manufacturers' instructions.
- C. Blend carpet tiles from different cartons to ensure minimal variation in color match.
- D. Lay out each room or area to minimize tiles less than one half size.
- E. Cut tile clean. Fit tiles tight to intersection with vertical surfaces without gaps.
- F. Lay carpet tile to specified pattern. See drawings for pattern direction.

3.3 INSTALLATION OF EDGINGS

- A. Install strips where carpet tiles abut dissimilar flooring materials; secure to subfloor.
- B. Center strips under doors where carpet tiles terminate at door openings.
- C. Install in longest practical lengths; butt ends tight.
- D. Scribe to abutting surfaces.

3.4 CLEANING

- A. Clean spots as recommended by carpet tile manufacturer.
- B. Cut off loose threads flush with top surface.
- C. Clean with commercial vacuum cleaner.

END OF SECTION

SECTION 09 81 13
ACOUSTICAL BOARD INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section 09 00 00 Finishes

1.2 RELATED SECTIONS

- A. Section 06 10 00 – Rough Carpentry: Installation and requirements for wood substrates and structure.
- B. Section 09 20 00 – Gypsum Board: Installation and requirements for wall assemblies.

1.3 REFERENCES

- A. APA The Engineered Wood Association (APA): APA AFG-01 – Specification for field gluing subfloors.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM C 209 - Test Methods for Cellulosic Fiber Insulating Board.
 - 2. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 3. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials.
 - 4. UL listed, File R16381.
 - 5. Forest Stewardship Certification (FSC): CoC Cert no. 5682.
 - 6. ICC-ES Report ESR-1374.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- 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. Installation methods.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 10 years experience in producing sound-deadening boards.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging with labels intact until ready for installation.
- B. Inspect the materials upon delivery to assure that specified products have been received. Report damaged material immediately to the delivering carrier and note such damage on the carrier's freight bill of lading.
- C. Store materials in a dry place, indoors, on raised platform protected from weather damage.

1.7 PROJECT 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.
- B. Climatize panels to existing moisture conditions and for not less than 24 hours before installation. Comply with manufacturer's recommendations for acclimatization.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Homasote Company; (www.homasote.com)
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.
- C. Provide all acoustical wall panels from a single manufacturer.

2.2 MATERIALS

- A. 440 SoundBarrier: Class C fire-rated. Molded, recycled post-consumer paper, cellulose fiber structural panel. Physical properties as follows:
 - 1. Thickness: 1/2 inch (13 mm).
 - 2. Density: 26-28 pcf (416-448 kg/cu. m) tested in accordance with ASTM C 209.
 - 3. Tensile Strength: When tested in accordance with ASTM C 209:
 - a. Parallel: 450-700 psi (3,100-4,830 kPa).
 - b. Transverse: 750-1000 psi (5.1171-6.894 kPa).
 - 4. Hardness (Janka Ball): 230 lbs (104 kg) tested in accordance with ASTM D 1037.
 - 5. Water Absorption by Volume: When tested in accordance with ASTM C 209:
 - a. 2 hour immersion: 7 percent maximum.
 - 6. Expansion: 50 to 90 percent relative humidity, 0.25 percent in accordance with ASTM C 209.
 - 7. Thermal Resistance: When tested in accordance with ASTM C 209 per ASTM C 518:
 - a. R-value: 1.2 for 1/2 inch (13 mm) thick board.
 - b. K-value: .512 Btu-in/ (h ft² °F).
 - 8. Noise reduction coefficient (NRC): 0.20
 - 9. Flame Spread: 76 to 200 tested in accordance with ASTM E 84, Class III or C.

2.3 ACCESSORIES

- A. Adhesive: APA AFG-01 specification sub-floor adhesive.
- B. Wall Panel Fasteners:
 - 1. Nails, Wood Framing: Length required penetrating wood framing 3/4 inch (19 mm) minimum.
 - 2. Screws:
 - a. General: 20 gauge or heavier, self-tapping drywall type steel screw.
 - b. Wood Framing: Coarse thread drywall type wood screw, length as required to penetrate framing 3/4 inch (19 mm) minimum.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates upon which work will be installed.
- B. Verify framing member spacing complies with manufacturer's requirements depending on substrates and installation methods.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Verify what environmental conditions are, and will continue to be maintained in accordance with manufacturer's recommendations.
- E. Starting work by installer is acceptance of substrate and environmental conditions.

3.2 PREPARATION

- A. Follow manufacturer's instructions by separating and allowing panels to be exposed to environmental temperature and humidity conditions for not less than 24 hours before start of installation.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install only clean dry panels. **Do not install wet panels.**
- C. Wall Panel Installation: Space panel joints 1/8 inch (3 mm) apart; 1/4 inch (6 mm) space at floors, ceilings, and window and door frames. Install gypsum wallboard or other wall finish panels so that finish panel joints are staggered and do not coincide with sound barrier panel joints. Install in accordance with finish panel manufacturer's installation recommendations.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

3.5 CLEANING

- A. Comply with manufacturer's recommendations for repairing damaged panels.
- B. Replace panels that cannot be repaired.

END OF SECTION

SECTION 098400

CEMENTITIOUS WOOD FIBER CEILINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes:

1. Cementitious wood fiber plank acoustical ceiling system

B. Related Sections:

1. Section 09 21 16 – Gypsum Board
2. Divisions 23 – HVAC Air Distribution
3. Division 26 – Electrical

1.3 REFERENCES

1. American Society for Testing and Materials (ASTM)
2. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
3. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
4. ASTM E2768-11(2018) Standard Test Method for Extended Duration Surface Burning Characteristics of Building Materials
5. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
6. ASTM C636 / C636M - 19 Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
7. ASTM C 754 Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board
8. ASTM E 1264 Classification for Acoustical Ceiling Products
9. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

B. International Building Code

C. ASHRAE Standard 62.1-2004, "Ventilation for Acceptable Indoor Air Quality"

D. NFPA 70 National Electrical Code

E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures

F. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components

1.4 SYSTEM DESCRIPTION

Direct attached acoustical ceiling systems manufactured from domestic cementitious wood fiber.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each type of Tectum® Direct-Attached™ ceilings required.
- B. Samples: Minimum 6 inch x 6 inch samples of specified Tectum® Direct-Attached interior panels.
- C. Shop Drawings: Layout and details of Tectum® Direct-Attached interior panels show locations of items that are to be coordinated with the installation as required.
- D. Certifications: UL certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. Acoustical performance, products must be tested to the C-20 method.

1.6 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

B. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate UL markings.

1. Surface Burning Characteristics: Tested per ASTM E 84 and complying with ASTM E 1264 Classification.

C. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.7 DELIVERY, STORAGE & HANDLING

- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Provide labels indicating brand name, style, size and thickness.
- C. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- D. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.8 PROJECT/SITE CONDITIONS

- A.Environmental Requirements:
- B.Do not install ceiling panels until building is closed in and conditioned with heat.
- C.Locate materials onsite at least 72 hours before beginning installation to allow materials to reach temperature and moisture content equilibrium.
- D.Maintain the following conditions in areas where acoustical materials are to be installed 72 hours before, during and after installation:
 - 1. Relative Humidity: 25 - 85%.
 - 2. Uniform Temperature: 32 - 120 degrees F (0 - 49 degrees C).

1.9 WARRANTY

- A. Tectum® Direct-Attached Ceiling Panels: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:
 - 1. Defects in materials or factory workmanship.
- B. Tectum® Direct-Attached Ceiling Panels warranty - Thirty (30) years from date of substantial completion.
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.10 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - 1. Tectum® Direct-Attached Ceiling Panels: Furnish quality of full-size units equal to 5.0 percent of amount installed.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Tectum® Direct-Attached Ceiling Panels:
 - 1. Tectum® by Armstrong World Industries, Inc.
- B. Tectum DesignArt - Lines Ceiling Panels:
 - 1. Tectum® by Armstrong World Industries, Inc.

2.2 TECTUM® DIRECT-ATTACHED CEILING PANELS

- A. Acoustical Panels Type AP-1:
 - Surface Texture: Coarse
 - Composition: Aspen wood fibers bonded with inorganic hydraulic cement
 - Finish: Surface appearance shall be consistent from panel to panel
 - Color: Standard Selection: Natural
 - Size: Standard 23 ¾" x 48"
 - Thickness: Standard 1"
 - Edge Profile: long edge/short edge – Bevel
 - UL Classified Noise Reduction Coefficient (NRC): ASTM C 423; Mounting C-20(0.80) Classified with UL label.
 - UL Classified Flame Spread: ASTM E 1264; Class A. Product must be able to meet this criteria after being painted six times.
 - Light Reflectance (LR) White Panel: ASTM E 1477;
 - Dimensional Stability/Mold Resistance: HumiGuard Plus and no significant mold growth when tested by ASTM D3273.
 - Sustainable: Third party verified EPD (Environmental Product Declaration) and HPD (Health Product Declaration) and Living Product Imperative Certification.
 - USDA Certified Biobased Product, 98%
 - Basis of design: Tectum® Direct-Attached 8175T10 __ __, as manufactured by Armstrong World Industries

2.3 METAL SUSPENSION SYSTEMS

A. Accessories:

1. #6 x 1-5/8" Painted Head Sharp Point Screws, item 8187L16
2. #6 x 1-5/8" Painted Head Drill Point Screws, item 8188L16
3. 2-1/4" Painted Head CMU Screws, item 8189L22

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of units. Coordinate panel layout with mechanical and electrical fixtures.
- B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

3.3 INSTALLATION

- A. Install Tectum® Direct-Attached Panels in accordance manufacturer's installation instructions.

3.4 ADJUSTING AND CLEANING

- A. Replace damaged and broken Tectum® Direct-Attached Panels.
- B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any Tectum® Direct-Attached Ceiling Panels that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

END OF SECTION

SECTION 098413
ACOUSTICAL WALL PANELS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fabric covered acoustical wall panels.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 2. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Shop Drawings: Indicate panel locations, sizes, attachment, and relationship to adjacent construction.
 - 2. Product Data: Manufacturer's descriptive data for wall panels.
 - 3. Samples:
 - a. 6 x 6 inch fabric samples in each specified color and pattern.
 - b. 12 x 12 inch panel samples showing backing, facings, and edges.
- B. Quality Control Submittals:
 - 1. Certification: Manufacturer's certification that Products comply with requirements for fire hazard classification.

1.4 QUALITY ASSURANCE

- A. Fabric: Tested to ASTM E84 with following results:
 - 1. Flame spread: Maximum 25.
 - 2. Smoke density: Maximum 450.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store materials in clean, dry storage area at minimum 40 degrees F and normal humidity.

1.6 PROJECT CONDITIONS

- A. Maintain minimum temperature of 50 degrees F in areas to receive wall panels for three days prior to, during, and after installation.

1.7 MAINTENANCE

- A. Extra Stock: 2 percent extra fabric in each color and pattern.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Kinetics Noise Control. (www.kineticsnoise.com)
 - 2. AVL Systems, Inc. (www.avlonline.com)
 - 3. Conwed Designscape Corp. (www.conweddesignscape.com)
 - 4. Armstrong. (www.armstrongceilings.com)
 - 5. MBI Products Company, Inc. (www.mbiproducs.com)
- B. Substitutions: Under provisions of Division 01.

2.2 MANUFACTURED UNITS

- A. Fabric Covered Wall Panels:
 - 1. Basis of Design: MBI COLORSONIX
 - 2. Fabric Color: Guilford of Main – Underground 2967 – 030 Pepper
 - 3. Facings: 100 percent polyester fabric, ANCHORAGE 2335 by Guilford of Maine, color to be selected.
 - 4. Impact Face / Tackable: 1/8" x 12-16# facing.
 - 5. Backing: Fiberglass, 6.0 to 7.0 PCF density, 1 inch thick.
 - 6. Noise reduction coefficient: Minimum 0.85, tested to ASTM C423.
 - 7. Edges: Square, hardened with non-resin, Class A hardening solution.
 - 8. Corners: Square.
 - 9. Size: See drawings.

2.3 ACCESSORIES

- A. Mounting Accessories: Z-clips.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prepare substrate to receive wall panels:
 - 1. Remove high spots.
 - 2. Clean surfaces of materials that could impair adhesion.

3.2 INSTALLATION

- A. Install panels in accordance with manufacturer's instructions and approved Shop Drawings.
- B. Secure panels with Z-clips spaced maximum 24 inches on center.
- C. Place panels plumb, level, and evenly spaced.

END OF SECTION

SECTION 099100

PAINTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Surface preparation and field application of paints.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. D4442 - Standard Test Method for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
 - 2. D6886 - Standard Test Method for Speciation of the Volatile Organic Compounds (VOCs) in Low VOC Content Waterborne Air-Dry Coatings by Gas Chromatography.
 - 3. ASTM E119, "Standard Test Methods for Fire Tests of Building Construction and Materials"
 - 4. ASTM E84, "Standard Test Method for Surface Burning Characteristics of Building Materials"
 - 5. ASTM D2240, "Standard Test Method for Rubber Property—Durometer Hardness"
 - 6. ASTM D2794, "Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)"
 - 7. ASTM D4060, "Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser"
 - 8. ASTM D4541, "Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers"
 - 9. ASTM E329-09, "Standard Specification for Agencies Engaged in Construction Inspection and Testing"
- B. Green Seal, Inc. (GS) 11 - Standard for Paints and Coatings.
- C. Master Painters Institute (MPI)- Architectural Painting Specification Manual.
- D. Society for Protective Coatings (SSPC) - Painting Manual.
- E. National Fire Protection Association, NFPA 251
- F. Underwriters Laboratories Inc. (UL) ANSI/UL263
- G. Association of the Wall and Ceiling Industry, AWCI Technical Manual 12-B, current edition.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Product Data: Manufacturer's data on materials proposed for use including:
 - a. Product designation and grade.
 - b. Product analysis and performance characteristics.
 - c. Standards compliance.
 - d. Material content.
 - e. Mixing and application procedures.
 - 2. Samples:
 - a. 3 x 6 inch samples of each coating system on representative substrate. Step back successive coats so that all coats remain exposed. Indicate type of material used for each coat.
 - b. 12 x 12 inch texture samples on gypsum board backing.
 - 3. Fire Resistance Rating Listings: UL or other accredited testing agency indicating type and size of steel member to receive intumescent coatings and minimum dry thickness (mils) to achieve specified fire resistance rating.

4. Paint Schedule: Indicate types and locations of each surface, paint materials, and number of coats to be applied.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Minimum 5 years documented experience in work of this Section.
- B. Materials, Preparation, and Workmanship: Conform to MPI Painting Manual.
- C. Mockup:
 1. Construct mockup panels for interior and exterior wall finishes, 4 feet wide x full height.
 2. Show: Each color and texture.
 3. Locate where directed.
 4. Approved mockup may remain as part of the Work.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Container Labels: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage rates, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- B. Paint Materials: Store at ambient temperature from 45 to 90 degrees F in ventilated area, or as required by manufacturer's instructions.

1.6 PROJECT CONDITIONS

- A. Do not apply materials when surface and ambient temperatures or relative humidity are outside ranges required by paint manufacturer.
- B. Maintain ambient and substrate temperatures above manufacturer's minimum requirements for 24 hours before, during, and after paint application.
- C. Do not apply materials when relative humidity is above 85 percent or when dew point is less than 5 degrees F different than ambient or surface temperature.
- D. Provide lighting level of 30 foot candles at substrate surface.

1.7 MAINTENANCE

- A. Extra Materials: 1 gallon of each color and sheen.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Paint Manufacturers:
 1. Basis of Design: Sherwin Williams. (www.sherwin-williams.com)
 2. PPG Paints (www.ppgpaints.com)
 3. Miller Paints (www.millerpaint.com)
 4. Benjamin Moore Paints (www.benjaminmoore.com)
- B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Paints:
 1. As scheduled at end of Section, or approved substitute.
 2. Free from all forms of lead and mercury.
 3. Colors: Walls = Sherwin Williams SW6168 Moderne White, Concrete Slab = Sherwin Williams SW7067 Cityscape, Exposed Conduit/Piping/Ducts = SW7067 Cityscape, Hollow Metal Frames = SW7069 Iron Ore, Hollow Metal Doors = SW7018 Dovetail
- B. Low V.O.C.: Maximum Volatile Organic Compound (VOC) Content for interior paints, coatings, and accessories, tested to ASTM D6886:

1. Primers: 100 grams per liter.
2. Flat paints and coatings: 50 grams per liter.
3. Non-flat paints and coatings: 50 grams per liter.
4. Rust preventative coatings: 100 grams per liter.
5. Dryfall coatings: 150 grams per liter.

C. Gloss Ratings:

Gloss Designation	Units at 60 Degrees	Units at 85 Degrees
Flat	0 to 5	Maximum 10
Eggshell	10 to 25	10 to 35
Satin	20 to 35	Minimum 35
Semigloss	35 to 70	
Gloss	70 to 85	
High Gloss	Minimum 85	

2.3 ACCESSORIES

- A. Accessory Materials: Substrate primers, paint thinners and other materials required to achieve specified finishes; commercial quality.
- B. Patching Materials: Latex filler.
- C. Fastener Head Cover Materials: Latex filler.

2.4 MIXES

- A. Deliver paints pre-mixed and pre-tinted.
- B. Uniformly mix to thoroughly disperse pigments.
- C. Do not thin more than manufacturer's recommendations.
- D. Re-mix paint during application; ensure complete dispersion of settled pigment and uniformity of color and gloss.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Test shop applied primer for compatibility with subsequent coatings.
- B. Measure moisture content of surfaces using electronic moisture meter. Do not apply coatings unless moisture content of surfaces are below following maximums:
 1. Gypsum board: 12 percent.
 2. Wood: 15 percent, measured to ASTM D4442.

3.2 PREPARATION

- A. General:
 1. Protect adjacent and underlying surfaces.
 2. Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
 3. Correct defects and clean surfaces capable of affecting work of this section.
 4. Seal marks that may bleed through surface finishes with waterborne stain blocker.
- B. Impervious Surfaces: Remove mildew by scrubbing with solution of trisodium phosphate and bleach. Rinse with clean water and allow to dry.
- C. Exterior Concrete and Masonry:
 1. Wash with an appropriate cleaner as needed, rinse thoroughly and allow to dry.
 2. Remove all dirt, dust, mildew, loose particles, laitance, foreign material, peeling and defective coatings, chalk, etc.
 3. Fill holes, cracks and other voids with an approved compatible material.

- D. Gypsum Board and Plaster:
 - 1. Fill minor defects with filler compound. Spot prime defects after repair.
 - 2. Apply texture to match.
- E. Galvanized Steel: SSPC Method SP1 - Solvent Cleaning.
- F. Aluminum: SSPC Method SP1 - Solvent Cleaning.
- G. Uncoated Ferrous Metals: SSPC Method SP2 - Hand Tool Cleaning or Method SP3 - Power Tool Cleaning.
- H. Shop Primed Ferrous Metals:
 - 1. SSPC Method SP2 - Hand Tool Cleaning or Method SP3 - Power Tool Cleaning.
 - 2. Feather edges to make patches inconspicuous.
 - 3. Prime bare steel surfaces.
- I. Interior Wood:
 - 1. Wipe off dust and grit.
 - 2. Seal knots, pitch streaks, and sappy sections with sealer.
 - 3. Fill nail holes and cracks after primer has dried; sand between coats.

3.3 APPLICATION

- A. Apply paints in accordance with manufacturer's instructions and MPI Painting Manual, Premium Grade finish requirements.
- B. Apply primer or first coat closely following surface preparation to prevent recontamination.
- C. Do not apply finishes to surfaces that are not dry.
- D. Apply coatings to minimum dry film thickness recommended by manufacturer.
- E. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.
- F. Apply coatings to uniform appearance without laps, sags, curtains, holidays, and brush marks.
- G. Allow applied coats to dry before next coat is applied.
- H. When required on deep and bright colors apply an additional finish coat to ensure color consistency.
- I. Continue paint finishes behind wall-mounted accessories.
- J. Sand between coats on interior wood and metal surfaces.
- K. Match final coat to approved color samples.
- L. Where clear finishes are specified, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.
- M. Finish concealed surfaces of exterior wood.
- N. Mechanical and Electrical Components:
 - 1. Paint factory primed equipment.
 - 2. Remove unfinished and primed louvers, grilles, covers, and access panels; paint separately.
 - 3. Paint exposed pipe, conduit, boxes, metal ducts, hangers, brackets, collars, and supports unless factory finished.
 - 4. Paint exposed conduit and electrical panels in finished areas.
 - 5. Paint duct work behind louvers, grilles, and diffusers flat black to minimum of 18 inches or beyond sight line.
- O. **DO NOT PAINT:**
 - 1. Surfaces indicated on Drawings or specified to be unpainted or unfinished.
 - 2. Surfaces with factory applied finish coat or integral finish.
 - 3. Architectural metals, including brass, bronze, stainless steel, and chrome plating.
 - 4. Acoustical insulation jackets for Mechanical equipment.
 - 5. Name tags or identifying markings on Mechanical and Electrical equipment.

3.4 ADJUSTING

- A. Touch up or refinish disfigured surfaces.

3.5 CLEANING

- A. Remove paint from adjacent surfaces.

3.6 PAINT SCHEDULE

- A. Types of paint listed herein are set forth as standard of quality and type of coating required for each type of surface.
 - 1. Paint exposed surfaces of types listed in Paint Schedule.
 - 2. Paint other exposed surfaces not specifically listed with not less than two coats of appropriate type of coating.
- B. Prime coat consists of touch up on shop primed and existing surfaces with intact coatings.
- C. Use dry-fall products at ceilings.

3.7 SCHEDULE - EXTERIOR SURFACES

- A. New Wood, Opaque:
 - 1. One coat of latex primer sealer.
 - 2. Semi-gloss: Two coats of latex enamel.
- B. Existing Wood, Opaque:
 - 1. Semi-gloss: Two coats of latex enamel.
- C. Masonry/Concrete, Opaque:
 - 1. One coat of Acrylic Conditioner.
 - 2. Two coats of Elastomeric paint.
- D. Steel - Unprimed:
 - 1. One coat alkyd primer.
 - 2. Two coats of alkyd enamel.
- E. Steel - Shop Primed:
 - 1. Touch-up with zinc chromate primer.
 - a. M01 Inorganic Zinc Primer manufactured by Benjamin Moore.
 - 2. Two coats of alkyd enamel.
- F. Steel - Galvanized:
 - 1. One coat galvanize primer.
 - 2. Two coats of alkyd enamel.

3.8 SCHEDULE - INTERIOR SURFACES

- A. Gypsum Board:
 - 1. One coat of primer/ sealer.
 - 2. Two coats of latex acrylic enamel, eggshell.
- B. Wood Trim - Primed:
 - 1. Two coats of alkyd enamel, eggshell.
- C. Wood - Transparent:
 - 1. Filler coat (for open grained wood only).
 - a. Paste Wood Filler.
 - 2. One coat sealer.
 - 3. One coat of stain.
 - 4. Two coats of polyurethane varnish, satin.
- D. Concrete and CMU Walls:
 - 1. One coat of Interior/exterior Latex Block Filler - White.
 - 2. Two coats of Interior Latex.
- E. Steel – Shop Primed:
 - 1. Touch-up with primer.

2. Two coats of alkyd enamel, eggshell.

END OF SECTION

SECTION 101101
VISUAL DISPLAY BOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Enameled steel Markerboards.
- B. Glass Markerboards.

1.2 RELATED REQUIREMENTS

- A. Section 018113 – Sustainable Design Requirements.
- B. Section 092116 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

1.3 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2009.
- B. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2009a.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's data on markerboard, trim, and accessories.
- B. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
- C. Samples: Submit color charts for selection of color and texture of markerboard and trim.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 WARRANTY

- A. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.1 VISUAL DISPLAY BOARDS

- A. Enameled Steel Markerboard Manufacturers:
 - 1. AJW Architectural Products. (www.ajw.com)
 - 2. Claridge Products and Equipment. (www.claridgeproducts.com)
 - 3. MooreCo, Inc. (www.moorecoinc.com)
 - 4. Steelcase Inc. (www.steelcase.com)
 - 5. Substitutions: Section 016000 – Product Requirements.
- B. Glass Markerboard Manufacturers:
 - 1. Claridge Products and Equipment. (www.claridgeproducts.com)
 - 2. MooreCo, Inc. (www.moorecoinc.com)
 - 3. Polyvision. (www.polyvision.com)
 - 4. Egan Glasswrite. (www.egan.com)
 - 5. Substitutions: Section 016000 – Product Requirements.
- C. Markerboards (MB-1): Glass Marker Walls at Lobby L101
 - 1. Size: 4' x 8'.
 - 2. Color: To be selected from Manufacturer's full color line.
 - 3. Mounting and Orientation: Invisible cleat mounted, Portrait.
 - 4. Glass: Low-iron tempered, non-porous, non-ghosting, non-staining.

- D. Markerboards (MB-2): Porcelain enamel on steel, laminated to core.
 - 1. Steel Face Sheet Thickness: 24 gage, 0.0239 inch.
 - 2. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
 - 3. Backing: Aluminum foil, laminated to core.
 - 4. Size: 8' x 4'.
 - 5. Frame: Extruded aluminum with concealed fasteners.
 - 6. Marker Tray: Extruded aluminum with boxed end.
 - 7. Frame & tray Finish: Anodized, natural.

2.2 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- C. Foil Backing: Aluminum foil sheet, 0.005 inch thick.
- D. Adhesives: Type used and approved by manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates upon which work will be installed.
- B. Verify framing member spacing complies with manufacturer's requirements depending on substrates and installation methods.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Verify what environmental conditions are and will continue to be maintained in accordance with manufacturer's recommendations.
- E. Starting work by installer is acceptance of substrate and environmental conditions.

3.2 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Secure units level and plumb.

3.3 SCHEDULE

- A. Lobby L101: MB-1
- B. Language Lab 113: MB-2 Multiple instances
- C. Math Lab 135: MB-2 Multiple instances

END OF SECTION

SECTION 102113
PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Urinal screens.
- B. Solid plastic toilet compartments with enhanced privacy.

1.2 RELATED REQUIREMENTS

- A. Section 092116 - Gypsum Board Assemblies
- B. Section 102801 - Toilet, Bath and Laundry Accessories

1.3 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2015.
- C. ASTM E84 or UL 723 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.5 SUBMITTALS

- A. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- B. Samples: Submit two samples of partition panels, 4 by 4 inch in size illustrating panel finish, color, and sheen.

1.6 QUALITY ASSURANCE

- A. All Toilet Partition materials shall comply with standard, unmodified NFPA 286 or ASTM E84/UL723 testing.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide product with gap free enhanced privacy and minimal component height as follows:
 - 1. Panel height: 55 inches.
 - 2. Door height: 55 inches.

2.2 MANUFACTURERS

- A. Solid Plastic Toilet Compartments:
 - 1. Hadrian: www.hadrian-inc.com.
 - 2. Scranton Products: www.scrantonproducts.com
 - 3. Global Partitions: www.globalpartitions.com
 - 4. Metpar Corp: www.metpar.com.

2.3 SOLID PLASTIC TOILET COMPARTMENTS

- A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286 or ASTM E84/UL723, floor to ceiling mounted.
 - 1. Color: To be selected by Architect from full line of colors.
- B. Plastic Doors:
 - 1. Thickness: 1 inch.
 - 2. Width: 24 inch.
 - 3. Width for Handicapped Use: 36 inch, out-swinging.
 - 4. Height: 55 inch.
- C. Plastic Panels:
 - 1. Thickness: 1 inch.
 - 2. Height: 55 inch.
- D. Plastic Pilasters:
 - 1. Thickness: 1 inch.
 - 2. Width: As required to fit space; minimum 3 inch.
- E. Plastic Urinal Screens: Without doors; to match compartments; mounted to wall with full height stainless steel channels, and floor to ceiling 1 3/4" sq. support post.

2.4 ACCESSORIES

- A. Pilaster Shoes: Formed ASTM A666, Type 304 stainless steel with No. 4 finish, 4 in high, concealing floor and ceiling fastenings.
- B. Pilaster Brackets: Continuous channel type, satin stainless steel.
- C. Wall Brackets: Continuous channel type, satin stainless steel.
- E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
 - 1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.
- F. Hardware: Stainless Steel:
 - 1. Continuous hinges, heavy-duty, 14 gauge stainless steel.
 - a. Self closing ADA stall
 - 2. Door Latch: Slide type with exterior emergency access feature.
 - 3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
 - 4. Coat hook with rubber bumper; one per compartment, mounted on door.
 - 5. Provide door pull for out-swinging doors.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.

- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel channels securely to walls using anchor devices.
- D. Attach panels and pilasters to channels. Locate 3 inch stabilizer at 7 feet above finish floor continuous around interior of the compartment per manufacturer's requirements.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.3 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.4 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 102601
WALL AND CORNER GUARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Stainless Steel Corner Guards.

1.2 RELATED SECTIONS

- B. Section 018113 – Sustainable Design Requirements.

1.3 REFERENCE STANDARDS

- A. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
- B. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2003.

1.4 SUBMITTALS

- A. Product Data: Indicate physical dimensions, features, anchorage details, and rough-in measurements.
- B. Samples: Submit two sections of corner guard, 24 inch long, illustrating component design, configuration, color and finish.
- C. Provide an allowance of (20) corner guards for location by owner.

PART 2 PRODUCTS

2.1 COMPONENTS

- A. Corner Guards - Surface Mounted:
 - 1. Material: Type 304 stainless steel, No. 4 finish, 16 gage, 0.06 inch thick.
 - 2. Performance: Resist lateral impact force of 100 lbs at any point without damage or permanent set.
 - 3. Width of Wings: 2 inches.
 - 4. Corner: Square.
 - 5. Mounting: Adhesive
 - 6. Length: 48 +/- inches, field verify.
 - a. Starting at top of wall base.
 - 7. Products:
 - a. Basis of Design: Schluter; Product Eck-K
 - b. Or approved equal.
- B. Corner Guards - Surface Mounted: Formed ASTM A 666 one-piece unit without splices, installed with adhesive.
 - 1. Performance: Resist lateral impact force of 100 lbs at any point without damage or permanent set.
- C. Mounting Brackets and Attachment Hardware: Appropriate to component and substrate.
- D. Adhesive:
 - 1. Product:
 - a. Chemlink; Product M-1 Structural Adhesive; www.chemlink.com

2.2 FABRICATION

- A. Fabricate components with tight joints, corners and seams.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

3.2 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only.
- B. Position corner guard as shown on drawings.

3.3 TOLERANCES

- A. Maximum Variation From Required Height: 1/8 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/8 inch.

END OF SECTION

SECTION 102813

TOILET ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Toilet accessories at Gender Neutral Restroom.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 018113 – Sustainable Design Requirements.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. A123/A123M - Standard Specification for Zinc (Hot-Galvanized) Coatings on Iron and Steel Products.
 - 2. A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - 3. A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 4. A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 5. B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - 6. C1036 - Standard Specification for Flat Glass.
- B. Underwriters Laboratories, Inc. (www.ul.com) - Listed Products.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Product Data:
 - a. Schedule accessories by room; show plans and elevations, and identify room name and number, type and quantity of accessories, and mounting heights.
 - b. Include manufacturer's brochures showing sizes, details of function, finishes, and attachment methods.
 - 2. Warranty: Sample warranty form.

1.4 QUALITY ASSURANCE

- A. Conform to applicable accessibility code for locating accessories.

1.5 WARRANTIES

- A. Mirror Warranty - Furnish manufacturer's 15 year warranty providing coverage against mirror silver spoilage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Bobrick Washroom Equipment, Inc. (www.bobrick.com)
 - 2. American Specialties, Inc. (www.americanspecialties.com)
 - 3. Bradley Corp. (www.bradleycorp.com)

- B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Stainless Steel:
 - 1. Sheet: ASTM A666, Type 304, rollable temper.
 - 2. Tubing: ASTM A269.
- B. Galvanized Steel:
 - 1. ASTM A1008/A1008M.

2.3 ACCESSORIES

- A. Fasteners: Stainless steel where exposed, hot dip galvanized where concealed; type best suited to substrate conditions.

2.4 FABRICATION

- A. Use stainless steel for exposed surfaces; galvanized steel may be used in concealed locations.
- B. Form exposed surfaces from single sheet of stock, free from joints, and flat, without distortion.
- C. Weld joints of fabricated components and grind smooth.
- D. Fabricate grab bars of tubing, free of visible joints, return to wall with end attachment flanges.
- E. Fabricate soap dispensers to operate with less than 5 pound force.
- F. Provide hangers, adapters, anchor plates, and accessories required for installation.
- G. Key locks alike; furnish six keys.
- H. Shop assemble units and package complete with anchors and fittings.

2.5 FINISHES

- A. Stainless Steel: No. 4 satin.
- B. Galvanizing: ASTM A123/A123M to 1.25 ounces per square foot.
- C. Chrome Plating: ASTM B456, Type SC 2, polished.
- D. Polyethylene: White.
- E. Enamel: White.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Set plumb, level, square, and rigid.

3.2 SCHEDULE

MARK	DESCRIPTION	MANUFACTURER	MODEL NO.
GB	Grab Bars (42", 36", 18")	Bobrick	B-5806
MR-1	24" x 36" Mirror	Bobrick	B-165

END OF SECTION

SECTION 104413

FIRE EXTINGUISHER CABINETS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire Extinguisher Cabinets.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 018113 – Sustainable Design Requirements.

1.2 REFERENCES

- A. ASTM International (ASTM) E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops.
- B. National Fire Protection Association (NFPA) 10 - Portable Fire Extinguishers.
- C. Underwriters Laboratories (UL):
 - 1. 154 - Carbon Dioxide Fire Extinguishers.
 - 2. 299 - Dry Chemical Fire Extinguishers.
 - 3. 626 - 2-1/2 Gallon Stored Pressure, Water Type Fire Extinguishers.
 - 4. 711 - Rating and Fire Testing of Fire Extinguishers.
 - 5. 2129 - Halocarbon Clean Agent Fire Extinguishers.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Shop Drawings: Indicate cabinet locations and mounting heights.
 - 2. Product Data: Include data on extinguishers and cabinets, cabinet dimensions, operational features, materials, finishes, and anchorage.
- B. Closeout Submittals:
 - 1. Maintenance Data: Include test, refill, or recharge schedules and re-certification requirements.

1.4 QUALITY ASSURANCE

- A. Provide fire extinguishers complying with UL 711 and NFPA 10.
- B. Cabinets in Fire Rated Partitions: Tested in accordance with ASTM E814 with fire resistance rating equivalent to adjacent construction.
- C. Conform to applicable accessibility code for locating extinguishers.

1.5 PROJECT CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. JL Industries. (www.jlindustries.com)
 - 2. Nystrom (www.nystrom.com)
 - 3. Larsen's Mfg. Co. (www.larsensmfg.com)
- B. Substitutions: Under provisions of Division 01.

2.2 COMPONENTS

A. Cabinets:

1. Basis of Design: Larsen's Mfg. Co., Architectural Series Vertical Duo cabinet.
 - a. 2409-R2 at non-fire rated walls.
2. Formed 304 stainless steel with #4 finish.
3. Configuration: Recessed, interior nominal dimension of 24 inch high x 9 ½ inch wide x 6 inch deep.
4. Weld, fill, and grind components smooth.
5. Pre-drill for anchors.
6. Trim: Flat trim, 5/15 inch.
7. Door:
 - a. ½" thick hollow metal heavy gauge door.
 - b. Vertical glass style, equipped with pull handle and roller latch.
 - c. Hinge doors for 180 degree opening with continuous piano hinge.
 - d. Glazing: Clear tempered glass.
 - e. Graphics: Letter FIRE EXTINGUISHER vertically on door in red die-cut vinyl pressure sensitive letters.

2.3 ACCESSORIES

- ### A. Mounting Hardware: Type best suited to application.

2.4 FINISHES

A. Cabinet:

1. Exterior and door: Stainless steel with #4 finish.
2. Interior: Stainless steel.

PART 3 EXECUTION

3.1 INSTALLATION

- #### A. Install cabinets in accordance with manufacturer's instructions.
- #### B. Set plumb, level, and rigid.
- #### C. Place an extinguisher in each cabinet.

3.2 SCHEDULE

- #### A. Provide two (2) cabinets, see drawings for locations.

END OF SECTION

SECTION 123661

QUARTZ SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Quartz surfacing countertops and backsplashes.
- B. Adhesives and sealants.

1.2 RELATED REQUIREMENTS

- A. Section 01 3000 - Submittals.
- B. Section 01 7800 - Closeout Submittals.
- C. Section 05 5000 - Metal Fabrications.
- D. Section 06 1000 - Rough Carpentry.
- F. Section 07 9200 - Joint Sealants.

1.3 REFERENCES

A. Reference Standards:

1. ASTM C 97: Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
2. ASTM C 170: Standard Test Method for Compressive Strength of Dimension Stone.
3. ASTM C 501: Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic tile by the Taber Abraser.
4. ASTM C 834: Standard Specification for Latex Sealants.
5. ASTM C 920: Standard Specification for Elastomeric Joint Sealants.
6. ASTM D 790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
7. NSF/ANSI Standard 51: Food Equipment Materials.
8. ISO: International Organization for Standardization.
9. ISO 9001: Quality Management Systems.
10. SCAQMD Rule 1168: Adhesive and Sealant Applications.
11. UL 2818: GREENGUARD Certification Program for Chemical Emissions for Building Materials, Finishes and Furnishings.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 3000 - Submittals.
- B. Product Data:
 1. Submit product data for each specified product. Include manufacturer's technical data sheets and published instruction instructions.
 2. Submit Safety Data Sheets (SDS) for adhesives and sealants.
- C. Shop Drawings:
 1. Submit fully dimensioned shop drawings showing countertop layouts, backsplashes, sidesplashes, waterfall ends, joinery, edge conditions, terminations, substrate construction, cutouts and holes. Show plumbing installation provisions. Include elevations, section details, and large scale details.
- D. Samples:

1. Submit selection and verification samples for each color and pattern required.

E. Quality Assurance Submittals:

1. Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties, if required.
2. Warranty: Specimen copy of specified warranty.

1.5 REGULATORY REQUIREMENTS

- A. Accessibility Requirements: Comply with the U.S. Architectural & Transportation Barriers Compliance Board ADA-ABA Accessibility Guidelines for Buildings and Facilities.
- B. Adhesives, Sealants, and Sealant Primers:
1. SCAQMD (South Coast Air Quality Management District) Rule 1168.

1.6 QUALITY ASSURANCE

- A. Qualifications:
1. Manufacturing Facility Qualifications: Quartz surfacing materials produced in an ISO 9001 certified facility.
 2. Fabricator Qualifications: Minimum of five years documented experience in fabricating quartz surfacing countertops similar in scope and complexity to this Project, using water-cooled cutting tools. Currently certified by the manufacturer as an acceptable fabricator.
 3. Installer Qualifications: Minimum of five years documented installation experience for projects similar in scope and complexity to this Project, and currently certified by the manufacturer as an acceptable installer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Handling: Comply with manufacturer's recommendations for shipping and handling quartz surfacing materials to preclude breakage or damage. Brace quartz surfacing units as necessary during shipment, transporting in near-vertical position with finished face towards finished face. Do not allow finished surfaces to rub during shipping and handling.
- B. Storage and Protection: Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer. Store quartz surfacing sheet materials on racks in near-vertical position to preclude damage. Store with finished face turned towards finished face. Prevent warpage and breakage.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual measurements and openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.
- B. Adhesive: Acclimate adhesives to occupancy room temperatures with maximum temperature not to exceed 75 deg F.

1.9 WARRANTY

- A. Manufacturer's Limited Warranty: Provide manufacturer's standard 10 Year Commercial and Residential Limited Warranty against defects in quartz surfacing sheet materials.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Acceptable Manufacturers:
1. Cambria (www.cambriausa.com)

2. DuPont. (www.zodiaq.com)
3. Formica Corp. (www.formica.com)
4. Wilsonart International, Inc. (www.wilsonart.com)
5. CaesarStone US. (www.caesarstoneus.com)
6. Silestone (www.silestoneusa.com)

B. Substitutions: Under provisions of Division 01.

2.2 QUARTZ SURFACING SHEET MATERIAL

- A. Basis of Design: "Wilsonart Quartz."
- B. Composition: 93 percent quartz aggregate combined with polyester resin binders and proprietary pigments that are fabricated into slabs using vacuum vibrocompaction technology.
- C. Material Thickness: Product Type 062 - 0.79 inch (2 cm).
- D. Material Weight: 10 lbs./ft² for 2 cm thick surfacing.
- E. Countertop Dimensions: Indicated on Drawings
- F. Conformance Standards:
 1. NSF/ANSI Standard 51. 2. UL 2818:
 - a. GREENGUARD - Emission levels in UL 2818, Section 7.1 are applicable for furniture products.
 - b. GREENGUARD Gold - Emission levels in UL 2818, Section 7.2 are applicable for building materials, finishes, and furnishings.
- G. Physical Characteristics:
 1. Flexural Strength: Greater than 4,500 psi; ASTM D 790.
 2. Flexural Strain: Less than 0.375 percent; ASTM D 790.
 3. Flexural Modulus: Greater than 3.75 MPsi; ASTM D 790.
 4. Stain Resistance (24 Hour): No effect to moderate effect; NEMA LD-3.
 5. Abrasion Resistance: Greater than 100 in.-lbs.; ASTM C 501.
 6. Density: Greater than 2.1 g/cm³; ASTM C 97.
 7. Compressive Strength (One Axis - Dry): Greater than 20,000 psi; ASTM C 170.
 8. Moisture Absorption: Maximum 0.022 percent; ASTM C 97.
- H. Quartz Finish: Polished finish with Glossometer reading greater than 45.
- I. Color and Pattern: Selected from manufacturer's standard offerings.
- J. Edge Detail: Indicated on Drawings.

2.3 ACCESSORY MATERIALS

- A. Joint Adhesive: Methacrylate-based adhesive for chemically bonding quartz surfacing seams. Color complementary to quartz surfacing sheet material. UL 2818 GREENGUARD Gold certified and complies with SCAQMD Rule 1168.
 1. Basis of Design: "Wilsonart Hard Surface Adhesive."
 2. Other Acceptable Products: Pigmented knife grade adhesives suitable for use with quartz surfacing are also acceptable.
- B. Elastomeric Sealant: Mildew-resistant silicone sealant for filling gaps between countertops and terminating substrates in wet environment applications. Complies with ASTM C 920, Type S (single component), Grade NS (nonsag).
 1. Product: Acceptable to countertop manufacturer.
 2. Color: Complementary to quartz surfacing color.

- C. Siliconized Acrylic Sealant: Siliconized acrylic latex sealant. For general applications to fill gaps between countertops and at terminating substrates. Complies with ASTM C 834, Type OP, Grade NF, and SCAQMD Rule 1168.
 - 1. Product: "Wilsonart Color Matched Caulk".
 - 2. Color: Complementary to quartz surfacing color.
- D. Construction Adhesive: Countertop manufacturer's recommended silicone-based construction adhesive for backsplashes, sidesplashes, and other applications according to manufacturer's published fabrication instructions.

2.4 FABRICATION

- A. Fabricate components in shop, to greatest extent practicable, in sizes and shapes indicated according to approved shop drawings and Wilsonart Quartz Fabrication Manual.
- B. Form joint seams between quartz surfacing components with specified seam adhesive. Completed joints inconspicuous in appearance and without voids. Provide joint reinforced if required by manufacturer for particular installation conditions.
- C. Provide holes and cutouts for plumbing fixtures and accessories indicated on approved shop drawings. Rout cutouts and finish edges smooth.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions that could adversely affect the work of this Section.
- B. Substrates must be sound, flat, smooth, and free from dust or other surface contaminants.
- C. Commencement of work will constitute acceptance of substrates and conditions to receive the work.

3.2 COUNTERTOP INSTALLATION

- A. Install quartz surfacing components plumb, level, and true according to approved shop drawings and manufacturer's published installation instructions. Use woodworking and specialized fabrication tools acceptable to manufacturer.
 - 1. Fasten quartz surfacing components to base cabinets or other supporting substrates with suitable adhesives acceptable to manufacturer.
- B. Form joint seams with specified seam adhesive. Seams to be inconspicuous in completed work. Seams in locations shown on approved shop drawings and acceptable to manufacturer. Promptly remove excess adhesive.
 - 1. Clamp or brace quartz surfaces in position until adhesive sets.
- C. Fill gaps between countertop and terminating substrates with specified silicone sealant.
- D. Install backsplashes and sidesplashes where indicated on Drawings. Adhere to countertops with specified construction adhesive.

3.3 REPAIRS

- A. If permissible to Architect, minor surface marring for quartz surfacing components may be repaired according to manufacturer's published installation instructions.
- B. Remove and replace quartz surfacing components that are damaged and cannot be satisfactorily repaired.

3.4 CLEANING AND PROTECTION

- A. Clean quartz surfacing components according to manufacturer's published maintenance instructions. Completely remove excess adhesives and sealants from finished surfaces.
- B. Protect completed work from damage during remainder of construction period.

3.5 SCHEDULE

- A. All Countertops.

END OF SECTION

SECTION 210001
FIRE SPRINKLER DESIGN-BUILD PERFORMANCE SPECIFICATION

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. This project consists of a design build contract for an existing 40,105-square-foot academic and office building of Occupancy Type B, located at 1250 Siskiyou Boulevard, Ashland, Oregon. The building includes basement, first floor, second floor, and attic spaces. This Specification Section covers design/build performance requirements for the Fire Sprinkler systems. Complete build-out of the building will be performed in multiple phases. This phase will include tenant improvements on the second floor only.
- B. Prepare design documents, stamped and signed by a fire design professional, registered in Oregon, suitable for plan check submission and construction.
- C. Furnish material, labor, and equipment to achieve performance in accordance with applicable codes and standards.

1.2 ASSUMPTIONS

- A. The water supply and fire riser are installed (part of Phase 2).

1.3 REFERENCES

- A. Fire sprinkler design, work, and installation of materials and equipment shall be in accordance with the requirements of local laws, ordinances, the utility purveyors, Authorities Having Jurisdiction, and State codes listed below:
 - 1. NFPA 13, all appendices, installation of sprinkler systems
 - 2. NFPA, Automatic Sprinkler System Handbook
 - 3. NFPA 14, all appendices, standpipe and house systems
 - 4. NFPA 24, all appendices, private fire service mains
 - 5. State Fire Marshal requirements
 - 6. Local Fire District requirements
 - 7. Southern Oregon University Standards listed in paragraph 1.6 of this specification.
 - 8. Oregon Fire Code (OFC)
 - 9. Oregon Mechanical Specialty Code (OMSC)
 - 10. Oregon Plumbing Specialty Code (OPSC)
 - 11. Oregon Electrical Specialty Code (OESC)
 - 12. Oregon Structural Specialty Code (OSSC)
 - 13. Underwriters Laboratories Fire Protection Equipment Directory
- B. Conflicts, if any, that may exist among the above items will be resolved at the discretion of the Project Engineer.

1.4 REQUIREMENTS

- A. The Fire Sprinkler Drawings shall be provided by the Contractor.
- B. During design, four submittals shall be submitted to the Owner for review. Allow fourteen days for Owner's review:
 - 1. Schematic Design: 30 days after Notice to Proceed.
 - 2. Design Development: 60 days after Notice to Proceed.
 - 3. Construction Documents: 90 days after Notice to Proceed.
 - 4. Reviewing Agency Submittal: 10 days after receiving Reviewing Agency comments.
 - 5. Construction shall not commence until the detailed Drawings, Specifications, and engineering calculations have been accepted and approved by the Owner and the Reviewing Agency.
- C. Schematic Design and Design Development Submittals:
 - 1. Drawings shall be scalable, dated, stamped by an Engineer registered in the State of Oregon with the word "PRELIMINARY", and shall be provided in PDF or hardcopy format, 24" x 36" size.
 - 2. Each drawing shall have a border with a sheet number and sheet title.
 - 3. Specifications shall be provided in PDF or hardcopy format, 8.5" x 11" size.
- D. Construction Documents and Reviewing Agency Submittals:
 - 1. Drawings shall be scalable, dated, stamped and signed by the Contractor's registered design professional and shall be provided in hardcopy format, 24" x 36" size.
 - 2. Specifications shall be provided in PDF or hardcopy format, 8.5" x 11" size.
 - 3. Drawings and Specifications shall be suitable for submission to the Reviewing Agency for review.
- E. If applicable, coordinate with the mechanical, plumbing, and electrical design Contractors and their Engineers for the Fire Sprinkler equipment and piping being installed as part of this project.

1.5 SUBMITTALS FOR REVIEW

- A. Schematic Design Components:
 - 1. Drawings shall include:
 - 2. Proposed riser diagram.
 - a. Locations of equipment and fixtures.
- B. Design Development Components (in addition to Schematic Design Components):
 - 1. Drawings shall include:
 - a. Below grade Fire Sprinkler pipe drawing.
 - 2. Catalog cut sheets for new fire sprinkler system equipment and components, describing for each type:
 - a. Assigned Fixture tag.
 - b. Manufacturer and model number.
 - c. Dimensions.
 - d. Mounting type.
 - 3. Fire Sprinkler Specifications outline.
 - 4. All coordination with the Mechanical & Electrical Design Teams.
 - 5. All coordination with the Structural Design Team.
- C. Construction Documents Components (in addition to Design Development Components):
 - 1. Drawings shall include:
 - a. Complete Fire Sprinkler System Floor Plan Drawings.
 - b. Fire Sprinkler hydraulic calculations;
 - c. Design professional stamp with signature.
 - d. Fire Sprinkler Specifications.

- D. Reviewing Agency Submittal:
 - 1. Reviewing Agency comments and Contractor responses.
 - 2. Drawings with Reviewing Agency comments incorporated.
 - 3. Fire Sprinkler Specifications.
 - 4. Final stamped, signed and approved Drawings suitable for construction

1.6 SOUTHERN OREGON UNIVERSITY FIRE SUPPRESSION STANDARDS

- A. Systems and system component locations should be designed and located in areas that are not exposed to the weather therefore requiring additional insulation, heat tape, etc. measures.
- B. All kitchen spaces / applications must reference UL 300 compliance, IFC and the city of Ashland fire requirements.
- C. Suppression Requirements regarding kitchen hoods and ventilation.
- D. Furnish and install tamper switches, flow switches and weatherproof exterior bell. Electrical connection to be by building monitor contractor. Coordinate connection to ensure proper function of alarm and supervisory devices.
- E. Fire Suppression Piping:
 - 1. Interior Pipe Shall Be:
 - a. Steel Pipe: black steel; Schedule 40 or 10; ASTM A-53 or ASTM A-135; Type E; Grade A or B.
 - b. Steel pipe 1" to 2" is to be Schedule 40, or UL listed proprietary pipe similar to Allied Dyna- Thread for UL listed Threaded Corrosion Resistance Ratio (CRR) greater than or equal to 1.0.
 - c. Steel pipe 2-1/2" and larger is to be Schedule 40 or 10 and shall be verified to have a CRR of 1.0 or greater.
 - 2. Do not impede or limit access of doors, windows, openings, or head room; piping shall be configured to provide maximum amount of access for equipment maintenance.
 - 3. Pipe openings shall be closed with caps and/or plugged after installation to prevent entrance of foreign materials before final connection.
 - 4. Maintenance and Protection Requirements:
 - a. Flushing locations shall be provided per IBC Standard in accessible locations; reviewed and approved location by the Architect / Engineer and FMP.
 - b. Flushing Connections: 1-1/4" nipples with caps at extreme ends of all cross mains.
 - 5. Drains and Drips:
 - a. Piping shall drain back to the express drain located beside the standpipe/riser. Where this is not possible auxiliary drains must be provided and discharge location to be reviewed and approved by FMP.
 - b. Install auxiliary drains at low points in system.
 - c. Five or fewer trapped heads will not require a drain valve, but may be drained through plugged tee.
 - d. Drains are to have a 3/4" hose line connection.
 - e. If discharge of main drains, auxiliary drains, or inspector's test connections will cause exterior landscape or property damage a concrete splash block is to be provided to deflect flow and minimize damage.
- F. Fire Suppression Interior Joints/Fittings:
 - 1. Schedule 40, Black Steel Pipe Requires:
 - a. Screwed joints ANSI B2.1 or welded joints ANSI B31.10, B31.10a, B31.20b.
 - b. Mechanical grooved couplings joined by an UL and FM approved combination of bolted couplings, gaskets and grooves. Grooves may be rolled or cut and be dimensionally compatible with the coupling.

2. Schedule 10, Black Steel Pipe Requires:
 - a. Welded joints, ANSI B31.10, B31.10b.
 - b. UL and FM approved mechanical couplings. Couplings may be of the bolted rolled grooved type or the mechanical locking type. Grooves for the rolled grooved type shall be rolled only.
3. Cast Iron Screwed: ANSI B16.4.
4. Cast Iron Flanged: ANSI B16.1 or AWWA C207.
5. Fittings not allowed:
 - a. Lock screw plain end joints/fittings. ii. Snap-Let outlet.
 - b. F.I.T. fittings.
 - c. Gasket plain-end joints/fittings.
6. Mechanical pipe coupling housings shall be of malleable iron conforming to ASTM A 47, Grade 32510 or ductile iron conforming to ASTM A 536, Grade 65-45-12. Coupling nuts and bolts shall be of steel and conform to ASTM A 183.
7. Flange Gaskets: Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16" thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR).
8. Square head Bolts and Heave Hexagon Nuts: ASME B18.2.1 and ASME B18.2.2, and ASTM A 307, ASTM A 575, or ASTM A 576.
9. Saddle type mechanical tees are acceptable for tapping into existing supply mains.
10. Reductions in pipe sizes shall be made with one piece reducing fittings.
11. Provide listed and approved flexible couplings on sprinkler mains per applicable codes.
12. Install UL approved hangers and earthquake bracing to support sprinkler piping.
13. Provide loops or Victaulic couplings where piping crosses seismic joints in construction.
14. Provide dielectric unions wherever dissimilar piping materials are connected.
- G. Wall and Floor Penetrations:
 1. Provide UL listed assemblies for all penetrations through rated walls/floors.
 2. Holes for pipe passing through rated walls shall be filled to the manufacturer's recommended thickness with fire resistant caulk.
 - a. Wall and hard ceiling penetrations shall be fire stopped.
 3. Provide escutcheons for pipe penetrations through finished areas.
 4. Escutcheons shall be chromium plated iron or chromium plated brass, either one piece or split pattern, held in place by internal spring tension or set-screw.
- H. Hangers, Inserts, and Support:
 1. Comply with NFPA and OSSC requirements for all anchors & supports.
 2. Hangers shall be in accordance with IBC Standard 9-1.
 3. Manufacturers known to be acceptable: Michigan, Tolco.
 4. Hangers, brackets, supports, anchors, and related appurtenances are to be UL listed for pipe size(s) being suspended.
 5. Pipe may be anchored to corridor walls using unistrut and pipe clamp.
 6. Hanging of pipes from ductwork is prohibited.
- I. Fire Suppression Interior Control Auxiliary/Utility Valves:
 1. NO Milwaukee Butterball Ball Valves.
 2. Auxiliary/Utility Valves:
 - a. Manufacturers known to be acceptable: United Brass Works; Central; Gem; Kennedy; Victaulic.
 - b. Location and quantity of auxiliary drain valves are to be reviewed and approved by FMP.

- c. Globe and Angle Valve Manufacturers known to be acceptable: United Brass Works, Inc. 45S and 46S; Central F15 and F16.
 - d. Ball Valves Manufacturers known to be acceptable: Central; United Brass Works.
- J. Sprinkler Heads & Associated Equipment:
 - 1. Appropriately rated heads in all locations; especially skylights.
 - 2. Concealed heads are required in recreation centers, childcare centers, and any other location deemed appropriate by the FMP office.
 - 3. Quick Response Pendent Heads:
 - a. Finish is to be chrome in chrome recessed escutcheon.
 - b. Heads typically to be 165°F rated, K=5.6, NPT= 1/2". Fusing element to be metal link.
 - c. Manufacturers known to be acceptable: Viking; Reliable; Globe; Tyco.
 - d. Sprinklers being replaced shall be replaced with quick response heads of same temperature and orifice sizes. Original and replaced sprinkler heads shall be turned over to the FMP.
 - 4. Quick Response Upright Heads:
 - a. Finish shall be brass.
 - b. Heads typically to be 165°F rated, K=5.6, NPT= 1/2". Fusing element to be metal link.
 - c. Manufacturers known to be acceptable: Viking; Reliable; Globe; Tyco.
 - d. Sprinklers being replaced shall be replaced with quick response heads of same temperature and orifice sizes. Original and replaced sprinkler heads shall be turned over to the FMP.
 - 5. Quick Response Sidewall Heads:
 - a. Finish is to be chrome escutcheons and chrome coated sprinklers.
 - b. Heads typically to be 165°F rated, K=5.6, NPT= 1/2". Fusing element to be metal link.
 - c. Manufacturers known to be acceptable: Viking; Reliable; Globe; Tyco.
 - 6. Sprinkler Head Cabinet:
 - a. Contractor shall furnish extra sprinklers of each type installed; no less than 4 of each type.
 - b. Contractor shall furnish no less than two special sprinkler head wrenches or one head wrench for each sprinkler head box, whichever is greater.
 - c. Cabinet is to be located near main riser.
 - d. Manufacturer: Same as sprinkler head manufacturer.
- K. Fire-Stopping:
 - 1. Provide fire-stopping composed of components that are compatible with each other, the substrates forming openings, and items penetrating the fire-stopping as demonstrated by fire-stopping manufacturer based on testing and field experience.
 - 2. Intumescent Latex Seal Manufacturers known to be acceptable: The RectorSeal Corporation; 3M Fire Protection Products.
 - 3. Intumescent Putty Manufacturers known to be acceptable: General Electric Co.; International Protective Coatings Corp.; 3M Fire Protection Products.
- L. Joints:
 - 1. Shop welded joints will be permitted.
 - 2. Flanged joints or mechanical grooved couplings shall be provided where indicated or required by IBC Standard.
 - 3. Mechanical grooved pipe joints shall conform to AWWA C 606.
 - 4. Mechanical couplings and fittings shall be from the same manufacturer.
 - 5. Joints shall be in accordance with ANSI B1.20.

6. Joints shall be made using UL-04 listed or FM-P7825 approved combination of fittings, gaskets, and grooves.
7. Mechanical pipe couplings shall be of the bolted type and consist of a housing fabricated with a synthetic rubber gasket, nuts, and bolts to secure the unit together.
8. Gaskets shall be of molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D 2000.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 GENERAL

A. Drawings:

1. Coordinate Drawings with other disciplines, including architectural, structural, civil, landscape, mechanical (HVAC) and electrical.
2. Screened line types and fonts shall represent work that is not included in this contract.
3. Bold line types and fonts shall represent work that is included in this contract.
4. Revisions to Drawings after the Construction Documents submittal shall be noted with:
 - a. Revision notes in the drawing title block including the revision number, brief description, date, and initials of the person responsible for the revision.
 - b. "Clouds" encompassing the drawing revision.
 - c. "Delta" blocks adjacent to the clouds with revision numbers corresponding to the associated title block revision notes.
 - d. Fire Sprinkler System Design:
 - i) Fire Sprinkler calculations and design shall be performed in accordance with NFPA-13, the requirements of the Oregon Fire Code and the requirements of the local Authority Having Jurisdiction.
 - ii) Fire Suppression Water Service piping, below grade, shall be constructed from ductile iron, AWWA C151;
 - iii) Standard pressure wet pipe sprinkler piping system shall be designed to operate at a working pressure of 175 psig maximum;
 - iv) Design the sprinkler system, including a comprehensive engineering analysis, by a qualified professional engineer, using performance criteria specific to the site. The engineer shall be licensed and registered as a design professional in the State of Oregon.
 - v) Heated spaces shall be protected with a wet sprinkler system. Piping materials shall be carbon steel, minimum wall thickness shall be Schedule 10.
 - vi) Unheated spaces shall be protected with a dry sprinkler system. Automatic sprinklers shall be attached to piping containing compressed air. Piping materials shall be galvanized steel, minimum wall thickness shall be Schedule 30, or type L copper pipe.
 - vii) Coordinate with mechanical Contractor for location of piping.

B. Load Analysis:

1. Verify existing line sizes and water pressure as it relates to the city water service.

C. Installation:

1. Fire sprinkler piping shall not be installed below finished ceilings.
2. Sprinklers and piping shall not be installed lower than 7' above finished floor.
3. Fire sprinkler piping and sprinklers shall be coordinated with mechanical, electrical, and plumbing trades.

3.2 FIELD INVESTIGATION

- A. Perform an extensive field investigation and record information required to perform the Fire Protection System design described herein.
- B. The field investigation shall cover:
 - 1. All areas required to complete this project's scope of work.

3.3 UTILITY COORDINATION

- A. Coordinate with the water utility for new service, new utility pipeline requirements, and whether a site plan will be required in the Fire Protection drawing set. Coordinate requirements with the civil site plan and the Owner.
- B. Obtain written documentation stating the utility's requirements.

END OF SECTION

SECTION 220500
COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 3 and, as a result, not all items recorded here are required for Phase 4.
- B. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Plumbing demolition.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Supports and anchorages.
 - 10. Flashing.
 - 11. Firestopping relating to plumbing work.
 - 12. Firestopping accessories.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- 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. 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. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire-rated construction.
- G. 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.
- H. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.3 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

- B. 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.
- C. Through Penetration Firestopping Of Fire-Rated Assemblies: UL 1479 or ASTM E814 with 0.10-inch water gauge minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1 hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1 hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1 hour.
 - a. Floor Penetrations within Wall Cavities: T-Rating is not required.
- D. Through Penetration Firestopping Of Non-Fire-Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Non-Combustible Penetrating Items: Non-combustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by Authorities Having Jurisdiction for penetrating items connecting maximum of two stories.
- E. Fire-Resistant Joint In Fire-Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire-resistant rating as indicated on Drawings for assembly in which joint is installed.
- F. Fire-Resistant Joints between Floor Slabs and Exterior Walls: ASTM E119 with 0.10-inch water gauge minimum positive pressure differential to achieve fire-resistant rating as indicated on Drawings for floor assembly.

1.4 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.

1.5 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.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Refer to Section, PRODUCT REQUIREMENTS for environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

PART 2 PRODUCTS

2.1 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.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- D. 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.

2.3 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 3. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.4 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 degrees 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-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Separate companion flanges and steel bolts and nuts shall have 150-psig or 300-psig minimum working pressure where required to suit system pressures.

- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 degrees F.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 degrees F.

2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 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: Carbon steel. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 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 water stop, 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.

2.7 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.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 FLASHING

- A. Metal Flashing: 26-gauge-thick galvanized steel.
- B. Metal Counterflashing: 22-gauge-thick galvanized steel.
- C. Lead Flashing:
 - 1. Waterproofing: 5 pounds/square foot sheet lead.
 - 2. Soundproofing: 1 pound/square foot sheet lead.

- D. Flexible Flashing: 47-mil-thick sheet butyl; compatible with roofing.
- E. Caps: Steel, 22-gauge minimum; 16 gauge at fire-resistant elements.

2.9 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. Hilti Corp.
 - 3. 3M Fire Protection Products
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping.
 - 2. Foam Firestopping Compounds.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing And Sealant Firestopping: Composite fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.

2.10 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- C. General:
 - 1. Furnish UL-listed products.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- D. Non-Rated Surfaces:
 - 1. Stamped-steel, chrome-plated, hinged, split-ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 - 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop- type wall sleeve.

PART 3 EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Section, CUTTING AND PATCHING and Section, SELECTIVE STRUCTURE DEMOLITION for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Equipment to Be Removed: Disconnect and cap services and remove equipment.

- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 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. Sleeves are not required for core-drilled holes.
- N. Install sleeves for pipes passing through 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.
 - 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 pipes smaller than NPS 6.
 - 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.
 - 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.
- O. 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. 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. 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.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section, PENETRATION FIRESTOPPING for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 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. 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.
- H. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- I. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

2. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 INSTALLATION – FLASHING

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 inches by 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.
- C. Seal drains watertight to adjacent materials.
- D. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 INSTALLATION – FIRESTOPPING

- A. Install material at fire-rated construction perimeters and openings containing penetrating sleeves, piping, and other items, requiring firestopping according to manufacturer's instructions to maintain fire ratings.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

END OF SECTION

SECTION 220503
PIPES AND TUBES FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 3 and, as a result, not all items recorded here are required for Phase 4.
- B. This Section includes pipe and pipe fittings for the following systems:
 - 1. Domestic water piping, within 5 feet of building.
 - 2. Sanitary drain and vent piping, within 5 feet of building.
 - 3. Equipment drains and over flows.
 - 4. Unions.
 - 5. Underground pipe markers.
 - 6. Bedding and cover materials.

1.2 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes.
- C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.

1.3 QUALITY ASSURANCE

- A. Press copper installation shall be performed by a licensed contractor trained in installation of the specific manufacturer submitted.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section, PRODUCT REQUIREMENTS for transporting, handling, storing, and protecting products requirements.
- B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.6 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.7 COORDINATION

- A. Coordinate installation of buried piping with trenching.

PART 2 PRODUCTS

2.1 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L hard drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

2. Joints: Solder, lead free, (ASTM B32) or brazed, AWS A5.8 BCuP silver alloy with melting range 1,190 to 1,480 degrees F.

2.2 SANITARY DRAIN AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: CISPI 301, hubless.
 1. Fittings: Cast iron, CISPI 301.
 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
 - a. Manufacturer: Ideal Tridon or equal.

2.3 SANITARY DRAIN AND VENT PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 1. Fittings: Cast iron, CISPI 301.
 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.4 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tubing: ASTM B88, Type DWV hard drawn.
 1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.5 UNIONS

- A. Ferrous Piping: Class 150, malleable iron, threaded.
- B. Copper Piping: Class 150, bronze unions with brazed joints.
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- D. ABS Piping: ABS.

2.6 BEDDING AND COVER MATERIALS

- A. Bedding: Sand, ASTM C33; fine aggregate, natural or manufactured sand.
- B. Soil Backfill from Above Pipe to Finish Grade: Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.
- B. Verify trenches are ready to receive piping.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than 2 feet of cover.
- C. Establish minimum separation from other services in accordance with local code.
- D. Install pipe to elevation as indicated on Drawings.

- E. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4 depth; compact to 95% maximum density.
- F. Install pipe on prepared bedding.
- G. Route pipe in straight line.
- H. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- I. Pipe Cover and Backfilling:
 - 1. Backfill trench in accordance with Section, FILL.
 - 2. Maintain optimum moisture content of fill material to attain required compaction density.
 - 3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6 inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95% maximum density.
 - 4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 5. Do not use wheeled or tracked vehicles for tamping.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- C. Group piping whenever practical at common elevations.
- D. Sleeve pipe passing through partitions, walls, and floors.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not accessible.
- H. Contractor shall verify all fittings and joints have been properly sealed prior to charging the system.
- I. Install non-conducting dielectric connections wherever joining dissimilar metals.
- J. Slope piping and arrange systems to drain at low points.
- K. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- L. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- M. Install valves in accordance with Section, GENERAL-DUTY VALVES FOR PLUMBING PIPING AND EQUIPMENT.
- N. Insulate piping. Refer to Section, PLUMBING INSULATION.
- O. Install pipe identification in accordance with Section, IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT.

3.5 INSTALLATION - DOMESTIC WATER PIPING SYSTEMS

- A. Install domestic water piping system in accordance with ASME B31.9.

3.6 INSTALLATION - SANITARY WASTE AND VENT PIPING SYSTEMS

- A. Install sanitary waste and vent piping systems in accordance with Section, FACILITY SANITARY SEWERAGE.
- B. Install bell and spigot pipe with bell end upstream.
- C. Support cast iron drainage piping at every joint.

3.7 FIELD QUALITY CONTROL

- A. Test domestic water piping system in accordance with Authority Having Jurisdiction.
- B. Test sanitary waste and vent piping system in accordance with local Authority Having Jurisdiction.

3.8 CLEANING

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for cleaning requirements.

END OF SECTION

SECTION 220519
METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 3 and, as a result, not all items recorded here are required for Phase 4.
- B. This Section includes:
 - 1. Bimetallic-actuated thermometers.
 - 2. Filled-system thermometers.
 - 3. Liquid-in-glass thermometers.
 - 4. Thermowells.
 - 5. Dial-type pressure gauges.
 - 6. Gauge attachments.
 - 7. Test plugs.
 - 8. Test-plug kits.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers:
 - 1. Ashcroft Inc.
 - 2. Miljoco Corporation.
 - 3. Noshok.
 - 4. REOTEMP Instrument Corporation.
 - 5. Tel-Tru Manufacturing Company.
 - 6. Terice, H. O. Co.
 - 7. Watts Regulator Co.; a Division of Watts Water Technologies, Inc.
 - 8. Weiss Instruments, Inc.
- B. Standard: ASME B40.200.
- C. Case: Hermetically sealed; stainless steel with 3-inch nominal diameter.
- D. Dial: Non-reflective aluminum with permanently etched scale markings and scales in degrees F.
- E. Connector Type(s): Union joint, adjustable angle, with unified inch screw threads.
- F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- H. Window: Plain glass or plastic.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1% of scale range.

2.2 FILLED-SYSTEM THERMOMETERS

- A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
 - 1. Manufacturers:
 - a. Ashcroft Inc.

- b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. REOTEMP Instrument Corporation.
 - e. Trerice, H. O. Co.
 - f. Weiss Instruments, Inc.
- 2. Standard: ASME B40.200.
- 3. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
- 4. Element: Bourdon tube or other type of pressure element.
- 5. Movement: Mechanical, with link to pressure element and connection to pointer.
- 6. Dial: Non-reflective aluminum with permanently etched scale markings graduated in degrees F.
- 7. Pointer: Dark-colored metal.
- 8. Window: Glass or plastic.
- 9. Ring: Metal.
- 10. Connector Type(s): Union joint, adjustable, with locking device; with ASME B1.1 screw threads.
- 11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for thermowell installation shall be bare stem.
- 12. Accuracy: Plus or minus 1% of scale range.

2.3 LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers:
 - 1. Ashcroft Inc.
 - 2. Miljoco Corporation.
 - 3. Noshok.
 - 4. REOTEMP Instrument Corporation.
 - 5. Tel-Tru Manufacturing Company.
 - 6. Trerice, H. O. Co.
 - 7. Watts Regulator Co.; a Division of Watts Water Technologies, Inc.
 - 8. Weiss Instruments, Inc.
- B. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
 - 1. Standard: ASME B40.200.
 - 2. Case: Cast aluminum; 6-inch nominal size.
 - 3. Case Form: Back angle unless otherwise indicated.
 - 4. Tube: Glass with magnifying lens and blue organic liquid.
 - 5. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in degrees F.
 - 6. Window: Glass or plastic.
 - 7. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for thermowell installation shall be bare stem.
 - 8. Connector: 3/4 inch, with ASME B1.1 screw threads.
 - 9. Accuracy: Plus or minus 1% of scale range or one scale division, to a maximum of 1.5% of scale range.

2.4 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. Type: Stepped shank unless straight or tapered shank is indicated.
 5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
 6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
 7. Bore: Diameter required to match thermometer bulb or stem.
 8. Insertion Length: Length required to match thermometer bulb or stem.
 9. Lagging Extension: Include on thermowells for insulated piping and tubing.
 10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-transfer medium shall be mixture of graphite and glycerin.

2.5 PRESSURE GAUGES

- A. Manufacturers
1. AMETEK, Inc.; U.S. Gauge.
 2. Ashcroft Inc.
 3. Miljoco Corporation.
 4. Noshok.
 5. Palmer Wahl Instrumentation Group.
 6. REOTEMP Instrument Corporation.
 7. Tel-Tru Manufacturing Company.
 8. Terice, H. O. Co.
 9. Watts Regulator Co.; a Division of Watts Water Technologies, Inc.
 10. Weiss Instruments, Inc.
- B. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:
1. Standard: ASME B40.100.
 2. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 4. Pressure Connection: Brass, with NPS 1/4 or 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: Non-reflective aluminum with permanently etched scale markings graduated in psi.
 7. Pointer: Dark-colored metal.
 8. Window: Glass or plastic.
 9. Ring: Metal.
 10. Accuracy: Grade A, plus or minus 1% of middle half of scale range.

2.6 GAUGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or 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 or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket in vertical position in piping tees.
- B. Increase the pipe size and fitting size around the location of thermowells to minimize the restriction to flow due to the insertion of the thermowell.
- C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- D. Meters and gauges shall be installed so they can be read from the ground without a ladder.

- E. Install thermowells with extension on insulated piping.
- F. Fill thermowells with heat-transfer medium.
- G. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- H. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.
- I. Install valve and snubber in piping for each pressure gauge for fluids.
- J. Install test plugs in piping tees.
- K. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. On each hot water recirculation line upstream of the balance valve.
 - 3. Other locations as shown on Plans, piping schematics, and/or details.
- L. Install pressure gauges 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 hot water recirculation pump.
 - 4. Other locations as shown on Plans, piping schematics, and/or details.

3.2 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

3.3 ADJUSTING

- A. Adjust faces of meters and gauges to proper angle for best visibility.

3.4 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 degrees F.
- B. Scale Range for Domestic Hot-Water Piping: 0 to 200 degrees F.

3.5 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 160 psi.

END OF SECTION

SECTION 220523
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 3 and, as a result, not all items recorded here are required for Phase 4.
- B. This Section includes:
 - 1. Ball valves.
 - 2. Check valves.

1.2 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal requirements.
- B. Product Data: Submit manufacturer's catalog information with valve data and ratings for each service.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.

1.3 CLOSEOUT SUBMITTALS

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for submittal requirements.
- B. Project Record Documents: Record actual locations of valves.
- C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Refer to Section, PRODUCT REQUIREMENTS for environmental conditions affecting products on site.
- B. Do not install valves underground when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 Manufacturers:

- A. Apollo.
- B. Milwaukee.
- C. NIBCO.
- D. Hammond.
- E. Watts.
- F. Victaulic.
- G. Bell & Gossett.
- H. Mueller.

2.2 VALVE FEATURES, GENERAL

- A. All wetted materials and components used in potable water systems shall be lead free.
- B. Valve Design: Rising stem or rising outside screw and yoke stems.
 - 1. Non-rising stem valves may be used where headroom prevents full extension of rising stems.
- C. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.
- D. Sizes: Same size as upstream pipe, unless otherwise indicated.

- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.
- G. End Connections: As indicated in the valve specifications.
 - 1. Threads: Comply with ANSI B1.20.1.
 - 2. Solder-Joint: Comply with ANSI B16.18.
 - 3. Caution: Where soldered end connections are used, use solder having a melting point below 840 degrees F for gate, globe, and check valves; below 421 degrees F for ball valves.

2.3 BALL VALVES

- A. 2 Inches and Smaller: MSS SP 110, Class 150, bronze, two-piece body, chrome-plated bronze ball, full port, Teflon seats, blowout-proof stem, solder or threaded ends, lever handle.
 - 1. Full-port ball valve: two-piece, ASTM F1960 cold-expansion ends, with PEX-a reinforcing cold-expansion ring
 - 2. LF brass valve with a positive stop shoulder manufactured from C69300 brass
 - 3. In compliance with: 250 CWP, ANSI/NSF 359, ANSI/NSF 14/61, cNSF-us-pw_G lead free 0.25% Lead max., ASTM F1960, ASTM F 877,

2.4 CHECK VALVES

- A. Horizontal Swing Check Valves:
 - 1. 2 Inches and Smaller: MSS SP 139, Class 150, bronze body and cap, bronze seat, Buna-N disk, solder or threaded ends.
 - 2. 2-1/2 Inches and Larger: MSS SP 71, Class 125, cast iron body, bolted cap, bronze or cast-iron disk, renewable disk seal and seat, flanged ends.
- B. Spring-Loaded Check Valves:
 - 1. 2 Inches and Smaller: MSS SP 139, Class 250, bronze body, in-line spring lift check, silent closing, Buna-N disk, integral seat, soldered or threaded ends.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Refer to Section, ADMINISTRATIVE REQUIREMENTS for verification of existing conditions before starting work.
- B. Verify piping system is ready for valve installation.

3.2 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install 3/4-inch ball valves with cap for drains at main shutoff valves, low points of piping, bases of vertical risers, and at equipment.
- D. Install valves with clearance for installation of insulation and allowing access.
- E. Install check valves at least 5 pipe diameters from any pump or change in direction to avoid excessive turbulence that could damage the valve.
- F. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Section, ACCESS DOORS AND FRAMES.
- G. Refer to Section, HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT for pipe hangers.
- H. Refer to Section, PLUMBING INSULATION for insulation requirements for valves.
- I. Refer to Section, PIPES AND TUBES FOR PLUMBING PIPING AND EQUIPMENT for piping materials applying to various system types.

3.3 VALVE APPLICATIONS

- A. Install shutoff and drain valves at locations indicated on Drawings in accordance with this Section.
- B. Install ball valves for shutoff and to isolate equipment, part of systems, or vertical risers.
- C. Install spring-loaded check valves on discharge of water pumps.
- D. Install gate valves in domestic water systems for shutoff service.

3.4 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

- A. VALVES, 2 INCHES AND SMALLER:

<u>SERVICE</u>	<u>BALL</u>	<u>CHECK</u>
Domestic Hot and Cold Water	150	125

END OF SECTION

SECTION 220529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 3 and, as a result, not all items recorded here are required for Phase 4.
- B. This Section includes:
 - 1. Pipe hangers and supports.
 - 2. Hanger rods.
 - 3. Inserts.
 - 4. Formed steel channel.
 - 5. Equipment bases and supports.

1.2 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog, data including load capacity.
- C. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form and provide all of the noted required supporting documentation included in Section 01 81 13 Sustainable Design Requirements.
 - 2. Provide Product data, including VOC content and emissions testing documents showing compliance with requirements for low-emitting materials, for the following materials:
 - a. Adhesives, Sealants, Paints, and Coatings: Provide manufacturers General Emissions Evaluation verification in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010 or equivalent verification method. Provide product MSDS, SDS or other documentation confirming the VOC emission information for on-site wet applied products.

1.3 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- B. Perform work in accordance with applicable authority for welding hanger and support attachments to building structure.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Plumbing Piping - DWV:
 - 1. Conform to MSS SP58, MSS SP69, and MSS SP89.
 - 2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron or carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Pipe Sizes 2 Inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe Sizes 3 Inches and Smaller: Cast iron hook.
 - 6. Wall Support for Pipe Sizes 4 Inches and Larger: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.

8. Floor Support: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
- B. Plumbing Piping - Water:
 1. Conform to MSS SP58, MSS SP69, and MSS SP89.
 2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron or carbon steel, adjustable swivel, split ring.
 3. Hangers for Cold Pipe Sizes 2 Inches and Larger: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Carbon steel, adjustable, clevis.
 5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 6. Wall Support for Pipe Sizes 3 Inches and Smaller: Cast iron hook.
 7. Wall Support for Pipe Sizes 4 Inches and Larger: Welded steel bracket and wrought steel clamp.
 8. Vertical Support: Steel riser clamp.
 9. Copper Pipe Support: Copper-plated, carbon-steel ring.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FORMED STEEL CHANNEL

- A. Product Description: Galvanized 12-gauge-thick steel, with holes 1-1/2 inches on center.

PART 3 EXECUTION

3.1 PREPARATION

- A. Obtain permission from Architect before using powder-actuated anchors.
- B. Obtain permission from Architect before drilling or cutting structural members.

3.2 INSTALLATION – INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with MSS SP 58, MSS SP 69, and MSS SP 89.
- B. Install hangers with minimum 1/2-inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2-inch-minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Support vertical piping at every other floor. Support vertical cast iron pipe at each floor at hub.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper-plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. In locations where pipe is exposed prime coat and paint exposed hangers and supports to match the exposed structure. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation.

3.4 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts and accessories for mounting and anchoring equipment.
- C. Construct supports of formed-steel channel. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

END OF SECTION

SECTION 220553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 3 and, as a result, not all items recorded here are required for Phase 4.
- B. This Section includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Pipe markers.
 - 4. Ceiling tags.
 - 5. Labels.

1.2 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Product Data: Submit manufacturers' catalog literature for each product required.
- C. Shop Drawings: Submit list of valve and equipment tags.
- D. Samples: Submit one tags, labels, and pipe markers.
- E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- F. LEED Submittals:
 - 1. Complete the LEED Material Buyout Form and provide all of the noted required supporting documentation included in Section 01 81 13 Sustainable Design Requirements.
 - 2. Provide Product data, including VOC content and emissions testing documents showing compliance with requirements for low-emitting materials, for the following materials:
 - a. Adhesives, Sealants, Paints, and Coatings: Provide manufacturers General Emissions Evaluation verification in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010 or equivalent verification method. Provide product MSDS, SDS or other documentation confirming the VOC emission information for on-site wet applied products.

1.3 CLOSEOUT SUBMITTALS

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.4 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

PART 2 PRODUCTS

2.1 PLUMBING IDENTIFICATION MATERIALS

- A. Manufacturer:
 - 1. Allen Systems, Inc.
 - 2. Brady (W.H.) Co.; Signmark Div.
 - 3. Industrial Safety Supply Co., Inc.
 - 4. Seton Name Plate Corp.
 - 5. MSI (marketing Services, Inc.)

2.2 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved white letters on black background color.

2.3 TAGS

- A. Metal Tags:
 - 1. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges and shall include the following information:
 - 2. Valve number (coordinate numbering with the owner).
 - 3. Building area designation.
 - 4. Normal valve status (Open or Closed).
 - 5. Piping system served.
- B. Information Tags:
 - 1. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
- C. Ceiling Tags:
 - 1. Clear adhesive label with black bold lettering.

2.4 PIPE MARKERS

- A. Color And Lettering: Conform to ASME A13.1.
 - 1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- B. Plastic Tape Pipe Markers:
 - 1. Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 INSTALLATION

- A. During finish construction, owner will review labeling and tagging. Contractor shall obtain Owner approval on labeling and tagging prior to final closeout.
- B. Pipe labeling shall include direction of flow.
- C. Pipe labeling shall be positioned so that they can be seen from the normal angle of approach.
- D. Pipe labeling shall be installed in the following locations:
 - 1. Adjacent to all valves and flanges.
 - 2. Adjacent to all changes of direction.
 - 3. On both sides of wall and floor penetrations.
 - 4. At regular 20 ft intervals on straight runs or increments required by code if less than 20 ft.
- E. Shall comply with the sizing and standards listed in the schedules shown in this section.
- F. Ceiling tags:
 - 1. Shall be installed on the grid, not on the tiles.
 - 2. Shall be installed at key access points, valves, and equipment.
- G. Provide permanent signage, interior and exterior, at all utility boxes, vaults, manholes, main valves, etc.
- H. Install identifying devices after completion of coverings and painting.
- I. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

- J. Install labels with sufficient adhesive for permanent adhesion, and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- K. Install tags using corrosion resistant chain. Number tags consecutively by location.
- L. Identify water heaters, pumps, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.
- M. Identify control panels and major control components outside panels with plastic nameplates.
- N. Identify valves in main and branch piping with tags.
- O. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4-inch-diameter and smaller. Identify service, flow direction, and pressure. Install in clear view, and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

3.3 SCHEDULES

- A. Building systems and labeling standard for piping and valves.

Piping Labeling Standards	Valve Tag Descriptor
12# Steam	12#S
Air	AIR
Chilled Water Supply	CWS
Chilled Water Return	CWR
Cold Water	CW
Condensate	C
Condensate Return	CR
Distilled Water	DW
Heat Recovery Supply	HRS
Heat Recovery Return	HRR
Hot Water Supply	HWS
Hot Water Recirculated	HWR
Hot Water Heating Supply	HWHS
Hot Water Heating Return	HWHR
Lab Vent	Lab Vent
Lab Waste	Lab Waste
Natural Gas	GAS
Refrigeration Compressor Discharge	RCD
Refrigeration Compressor Suction	RCS
Roof Drain	RD
Solar Water Heating Supply	SWHS
Solar Water Heating Return	SWHR
Vent	VENT
Waste, Gravity	WASTE
Waste, Pumped	WASTE - PUMPED

- B.

C. Pipe labeling standards.

Outside Pipe Diameter (including insulation):		Minimum Length of Label Color Field:		Minimum Letter Height:	
Inches:	mm:	Inches:	mm:	Inches:	mm:
.75 – 1.25	19 – 32	8	203	.5	13
1.5 – 2	38 – 51	8	203	.75	19
2.5 – 6	64 – 152	12	305	1.25	32
8 – 10	203 – 254	24	610	2.5	64
>10	>254	32	813	3.5	89

END OF SECTION

**SECTION 220700
PLUMBING INSULATION**

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 3 and, as a result, not all items recorded here are required for Phase 4.
- B. Section Includes:
 - 1. Piping system insulation.
 - 2. Equipment insulation.

1.2 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Product Data: Submit product description, thermal characteristics, and list of materials and thickness for each service and location.
- C. Manufacturer's Installation Instructions: Submit manufacturer's published literature indicating proper installation procedures.

1.3 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.

PART 2 PRODUCTS

2.1 PIPE INSULATION

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - 1. Armacell
 - 2. Certainteed Corp.
 - 3. Johns Manville Insulations.
 - 4. Knauf Insulation
 - 5. Owens-Corning Fiberglas Corp.
- B. Man Made Mineral Fiber: ASTM C547; rigid molded, noncombustible.
 - 1. k (ksi) factor: 0.24 at 75 degrees F.
 - 2. Maximum service temperature: 850 degrees F.
 - 3. Vapor Retarder Jacket: White Kraft paper with glass fiber yarn and bonded to aluminized film, secured with self-sealing longitudinal laps and butt strips or with outward clinch expanding staples and vapor retarder mastic.
- C. Hydrous Calcium Silicate: ASTM C533; rigid molded, asbestos free, gold color.
 - 1. k (ksi) factor: 0.44 at 300 degrees F.
 - 2. Maximum Service Temperature: 1200 degrees F.
 - 3. Tie Wire: Stainless steel with twisted ends on maximum 12 inch centers.
- D. Cellular Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
 - 1. k (ksi) Value: 0.27 at 75 degrees F.
 - 2. Maximum Service Temperature: 220 degrees F.
 - 3. Connection: Waterproof vapor retarder adhesive.
- E. Jackets:
 - 1. PVC Plastic: One piece molded type fitting covers and sheet material, off-white color.

- a. Thickness: 10 mil.
 - b. Connections: Brush on welding adhesive.
2. Canvas Jacket: UL listed fabric, 6 oz per sq yd, plain weave cotton treated with dilute fire retardant lagging adhesive.
3. Aluminum Jacket: 0.025 inch thick sheet, embossed finish, with longitudinal slip joints and 2 inch laps, die shaped fitting covers with factory attached protective liner

2.2 EQUIPMENT INSULATION

- A. Flexible Mineral Fiber Blanket: ASTM C553; flexible, noncombustible.
 1. k (ksi) factor: 0.25 at 75 degrees F.
- B. Maximum service temperature: 250 degrees F.
- C. Density: 2.0 lb/cu ft density.
- D. Vapor Retarder Jacket: Kraft paper with glass fiber yarn and bonded to aluminized film, secured with self-sealing longitudinal laps and butt strips or with outward clinch expanding staples and vapor retarder mastic.
- E. Rigid Mineral Fiberboard: ASTM C612; rigid, noncombustible.
 1. k (ksi) factor: 0.24 at 75 degrees F.
- F. Maximum service temperature: 850 degrees F.
- G. Density: 3.0 lb/cu ft.
- H. Vapor Retarder Jacket: Kraft paper with glass fiber yarn and bonded to aluminized film, secured with self-sealing longitudinal laps and butt strips or with outward clinch expanding staples and vapor retarder mastic.
- I. Facing: One inch galvanized steel hexagonal wire mesh stitched on one face of insulation.
- J. Cellular Glass: ASTM C552; 'k' factor of 0.29 at 75 degrees F; 8.0 lb/cu ft density.
- K. Hydrous Calcium Silicate: ASTM C533; rigid molded, asbestos free, gold color.
 1. k (ksi) factor: 0.44 at 300 degrees F.
- L. Maximum Service Temperature: 1200 degrees F.
- M. Tie Wire: Stainless steel with twisted ends on maximum 12 inch centers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify piping and equipment has been tested before applying insulation materials.
- B. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

- A. Exposed Piping: Locate insulation and cover seams in least visible locations.
- B. Insulated Pipes Conveying Fluids Below Ambient Temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- C. Man-Made Mineral Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:
 1. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure-sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
- D. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- E. Man-Made Mineral Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure-sensitive adhesive system on standard factory-applied jacket and butt strips or both.

- F. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- G. Inserts And Shields:
 - 1. Application: Piping or Equipment 1-1/2 inches diameter or larger.
- H. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
- I. Insert Location: Between support shield and piping and under finish jacket.
- J. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
- K. Insert Material: Compression-resistant insulating material suitable for planned temperature range and service.
- L. Pipe Exposed In Mechanical Equipment Rooms Or Finished Spaces: Finish with PVC jacket and fitting covers.
- M. Factory Insulated Equipment: Do not insulate.
- N. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- O. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
- P. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- Q. Finish insulation at supports, protrusions, and interruptions.
- R. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- S. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

3.3 SCHEDULES

- A. For automatic-circulating hot water systems and externally heated (such as heat trace or impedance heating) systems, piping up to 2" shall be insulated with 1 inch of insulation having a conductivity not exceeding 0.27. Piping 2" and greater shall be insulated with 1-1/2" thickness. Domestic cold water piping shall be insulated with 0.5 inch of insulation for condensation control.

END OF SECTION

SECTION 221100
FACILITY WATER DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 3 and, as a result, not all items recorded here are required for Phase 4.
- B. This Section includes:
 - 1. Water pressure reducing valves.
 - 2. Backflow preventers.
 - 3. Thermostatic mixing valves.
 - 4. Balancing valves.
 - 5. Diaphragm-type compression tanks.
 - 6. System lubricated circulators.

1.2 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Product Data:
 - 1. Domestic Water Specialties: Submit manufacturer's catalog information, component sizes, rough-in requirements, service sizes, and finishes.
 - 2. Pumps: Submit pump type, capacity, and certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit installation instructions for pumps, valves, and accessories.

1.3 CLOSEOUT SUBMITTALS

- A. Refer to Section, Execution and Closeout REQUIREMENTS, for closeout procedures.
- B. Project Record Documents: Record actual locations of valves and equipment.
- C. Operation and Maintenance Data: Submit spare parts list, exploded assembly views, and recommended maintenance intervals.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section, PRODUCT REQUIREMENTS for product storage and handling requirements.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Refer to Section, PRODUCT REQUIREMENTS.
- B. Do not install underground piping when bedding is wet or frozen.

1.6 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 WATER PRESSURE REDUCING VALVES

- A. Manufacturers:
 - 1. Apollo.
 - 2. Watts.
 - 3. Zurn Wilkins.
- B. 2 Inches and Smaller: Threaded
- C. Certifications: NSF/ANSI 372, or ASSE 1003
- D. Material: Lead free bronze or brass. Suitable for potable water. Stainless steel and thermoplastic internal parts, inlet strainer.
- E. Diaphragm: Fabric reinforced
- F. Adjustment: Adjustable from 25-75 PSI.
- G. Max Pressure rating 300 PSI.
- H. Max Temperature Rating: at least 140°F.

2.2 BACKFLOW PREVENTERS

- A. Manufacturers:
 - 1. Apollo.
 - 2. Febco
 - 3. Watts.
 - 4. Zurn.
- B. Reduced Pressure Backflow Preventers:
 - 1. Comply with ASSE 1013.
 - 2. Bronze body, with bronze internal parts and stainless-steel springs.
 - 3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.3 WATER HAMMER ARRESTERS

- A. Manufacturers:
 - 1. Sioux Chief Mfg. Co
 - 2. Amtrol Inc.
 - 3. Josam Co.
 - 4. MIFAB Inc.
 - 5. Jay R. Smith Mfg. Co.
 - 6. Watts.
 - 7. Zurn.
- B. ASSE 1010; copper construction, bellows or piston type sized in accordance with PDI WH-201.
- C. Precharged suitable for operation in temperature range 34 degrees to 250 degrees and maximum 250 psi working pressure.

2.4 THERMOSTATIC MIXING VALVES, DIGITALLY CONTROLLED

- A. Manufacturers:
 - 1. Powers/Watts.
 - 2. Caleffi.
 - 3. Leonard Valve Co.
 - 4. Symmons Industries.

- B. Assembly: Pre-piped valve assembly, including copper piping, valves, valve motor operator, digital controller, sensors, Unistrut (or similar) frame, and complete wiring from controller to operator and sensors.
- C. Hot-Water Outlet Temperature Control: Adjustable 80 – 180°F, +/-2°F.
- D. Building Automation System Communicator Protocols: BACnet, Modbus.
- E. Lead-free piping and valves.
- F. Listings: ASSE 1017, UL873.

2.5 BALANCING VALVES

- A. Manufacturers:
 - 1. Caleffi.
 - 2. Bell and Gossett
 - 3. Leonard Valve Co.
 - 4. Powers
 - 5. Watts.
 - 6. Symmons Industries.
- B. Low-lead brass flowmeter body and headwork, flowmeter springs, stainless steel valve ball, PTFE valve ball seal seat, integral flowmeter with sight gauge, integral check valve.
- C. Maximum Working Pressure: 150 psi.
- D. Temperature Range: 14 to 230°F.
- E. Flow Rate Range: 0.5 to 1.75 gpm, 2 to 7 gpm, +/-10%.
- F. Comply with ANSI 372.
- G. Options:
 - 1. Outlet temperature gauge, 30 – 210°F.

2.6 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Manufacturers:
 - 1. Amtrol.
 - 2. Bell and Gossett.
 - 3. Taco.
- B. Low-lead brass flowmeter body and headwork, flowmeter springs, stainless steel valve ball, PTFE valve ball seal seat, integral flowmeter with sight gauge, integral check valve.
- C. Maximum Working Pressure: 150 psi.
- D. Temperature Range: 14 to 230°F.
- E. Flow Rate Range: 0.5 to 1.75 gpm, 2 to 7 gpm, +/-10%.
- F. Comply with ANSI 372.
- G. Options:
 - 1. Outlet temperature gauge, 30 – 210°F.
- H. Accessories: Pressure gauge and air-charging fitting, tank drain.

2.7 SYSTEM LUBRICATED CIRCULATORS

- A. Manufacturers:
 - 1. Taco
 - 2. Armstrong
 - 3. Bell and Gossett
 - 4. Grundfos
- B. All wetted materials and components used in potable water systems shall be lead free.

- C. Type: Horizontal shaft, single stage, direct connected with multiple-speed wet rotor motor for in-line mounting, for 140-psig maximum working pressure, 230 degrees F maximum water temperature.
- D. Casing: Bronze with flanged pump connections.
- E. Impeller, Shaft, Rotor: Stainless steel.
- F. Bearings: Metal impregnated carbon (graphite) and ceramic.
- G. Motor: Impedance protected, single speed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Refer to Section, ADMINISTRATIVE REQUIREMENTS for coordination and Project conditions.
- B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt inside and outside, before assembly.

3.3 INSTALLATION – ABOVE-GROUND PIPING

- A. Install non-conducting dielectric connections wherever joining dissimilar metals.
- B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- C. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- D. Group piping whenever practical at common elevations.
- E. Slope piping and arrange systems to drain at low points.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section, PLUMBING INSULATION.
- H. Provide access where valves and fittings are not accessible.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- J. Install domestic water piping in accordance with ASME B31.9.
- K. Sleeve pipes passing through partitions, walls, and floors. Refer to Section, HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT.
- L. Install firestopping at fire-rated construction perimeters and openings containing penetrating sleeves and piping.
- M. Install unions downstream of valves and at equipment or apparatus connections.
- N. Install valves with stems upright or horizontal, not inverted.
- O. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- P. Provide spring-loaded check valves on discharge of water pumps.
- Q. Provide flow controls in water circulating systems as indicated on Drawings.
- R. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, and interior and exterior hose bibs.

- S. Install water hammer arresters complete with accessible isolation valve on hot and cold-water supply piping where shown on drawings.

3.4 INSTALLATION - PRESSURE REDUCING VALVES

- A. Contractor shall install pressure reducing valves in accordance with manufacturers installation instructions and contract documents.
- B. Contractor shall set the pressure reducing valves to the outlet pressures shown on the contract documents.

3.5 INSTALLATION - THERMOSTATIC MIXING VALVES

- A. Plumb in accordance with the manufacturer's installation instructions and the contract documents.
- B. Installations on systems with hot water recirculators pushing water through the mixing valve shall have:
 - 1. Piping connections to push water through the water heater to the hot water side of the mixing valve, AND
 - 2. Piping connections to push water through the cold-water side of the mixing valve.
 - a. Connect recirculation piping to the cold-water side of the mixing valve as close to the valve as possible.
- C. Set the outlet temperature of the mixing valve to match the contract documents.
- D. Provide thermometers on inlets and outlet.

3.6 INSTALLATION - BALANCING VALVES

- A. Install in accordance with the manufacturer's installation instructions and the contract documents.
- B. Install in a manner that the valve settings, adjustments, dials, and pressure ports are accessible.
- C. Balancing:
 - 1. Contractor shall perform full system balancing across all balancing valves to maintain flows indicated on the contract documents. Iterative adjustments may need to be made.
 - 2. If required based on balancing valve type, Contractor shall use the calibration charts and differential pressure readings to set the flow through each balancing valve.

3.7 FIELD QUALITY CONTROL

- A. Refer to Section, QUALITY REQUIREMENTS for field inspecting, testing, adjusting, and balancing.
- B. Test domestic water piping system in accordance with applicable code and/or local Authority Having Jurisdiction.

3.8 CLEANING

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for cleaning requirements.
- B. Disinfect water distribution system in accordance with the state health department, local Authority Having Jurisdiction, and/or state plumbing code as required.

END OF SECTION

SECTION 221300
FACILITY SANITARY SEWERAGE

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 3 and, as a result, not all items recorded here are required for Phase 4.
- B. This Section includes:
 - 1. Cleanouts.

1.2 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes for sewage-ejectors and manholes.
- C. Product Data:
 - 1. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 2. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 - 3. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
 - 4. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.

1.3 CLOSEOUT SUBMITTALS

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for closeout procedures.
- B. Project Record Documents: Record actual locations of equipment and clean-outs.
- C. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include, spare parts lists, exploded assembly views for pumps and equipment.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section, Product Requirements for product storage and handling requirements.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Refer to Section, PRODUCT REQUIREMENTS
- B. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 CLEANOUTS

- A. Interior Finished Floor Areas: Lacquered cast-iron body with anchor flange, reversible clamping collar, threaded top assembly, and round scored cover with gasket in service

- areas and round or square depressed cover with gasket to accept floor finish in finished floor areas.
- B. Interior Finished Wall Areas: Line type with lacquered cast iron-body and round epoxy-coated cover with gasket, and round stainless steel access cover secured with machine screw.
- C. Interior Unfinished Accessible Areas: Caulked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than 12 inches of cover.
- C. Establish minimum separation of 12 inches from water piping in accordance with the plumbing code.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Route pipe in straight line.
- F. Install plastic ribbon tape continuously above pipeline. Refer to Section, IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

3.4 INSTALLATION – ABOVE-GROUND PIPING

- A. Establish invert elevations, slopes for drainage to 1/4 inch per foot minimum. Maintain gradients. Pipe 4 inch or larger in diameter shall be permitted to have a slope of not less than 1/8 inch per foot.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
 - 1. Encase exterior cleanouts in concrete flush with grade.
- C. Install floor cleanouts at elevation to accommodate finished floor.
- D. Provide non-conducting dielectric connections wherever joining dissimilar metals.
- E. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- F. Install piping to maintain headroom. Do not spread piping but instead conserve space.
- G. Group piping whenever practical at common elevations.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- I. Provide access where cleanouts and fittings are not accessible.
- J. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- L. Install bell and spigot pipe with bell end upstream.

- M. Sleeve pipes passing through partitions, walls, and floors.
- N. Install firestopping at fire-rated construction perimeters and openings containing penetrating sleeves and piping.
- O. Support cast iron drainage piping at every joint.

3.5 FIELD QUALITY CONTROL

- A. Test sanitary waste and vent piping system in accordance with local Authority Having Jurisdiction.

END OF SECTION

**SECTION 224000
PLUMBING FIXTURES**

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 3 and, as a result, not all items recorded here are required for Phase 4.
- B. Section Includes:
 - 1. Sinks.
 - 2. Service sinks.
 - 3. Bottle filler.
 - 4. Water closets
 - 5. Drinking fountains
 - 6. Urinals

1.2 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Manufacturer's Installation Instructions: Submit installation methods and procedures.

1.3 PERFORMANCE REQUIREMENTS

- A. Furnish and install all fixtures and equipment, complete and in place, fully functional and including all accessories and appurtenances required to perform the intended or indicated functions.

1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for closeout procedures.
- B. Operation and Maintenance Data: Submit fixture, trim, exploded view, and replacement parts lists.

PART 2 PRODUCTS

2.1 MATERIALS

- A. All materials employed in permanent construction shall be new, full weight, in first class condition, and suitable for space provided.
- B. All similar materials shall be of one manufacturer. Fixture trim for the entire job shall be supplied by the same manufacturer to the extent possible.
- C. Fixtures and their trim shall be complete in every respect, including such items as escutcheons, hanger plates, bolts, supplies, stops, traps, etc.
- D. All exposed metal parts of all fixtures, including faucets, waste fittings, indirect waste piping, waste plugs, strainers, flush valves, traps, supplies, and escutcheons shall be polished chrome-plated brass, unless otherwise specified including all parts within a base cabinet.

2.2 SYSTEM ACCESSORIES

- A. Fixture Supports & Carriers: All fixture supports shall be ANSI approved to adequately support the fixture. Carrier shall best suit the fixture arrangement and wall space available for the piping arrangement and materials employed.

2.3 FIXTURE CONNECTIONS

- A. Fixture Stops: Fixture stops shall be by the primary plumbing fixture manufacturer (such as American Standard or Kohler) or a specialty manufacturing company such as Brass Craft or McGuire. Stops shall be chrome-plated with threaded or solder connection on the water supply inlet. Jam nuts are acceptable only on the fixture side of the stop. Stop handles shall be tool or key operated.
- B. Fixture Risers: Risers shall be braided stainless steel.
- C. Closet Flange: A heavy cast-iron closet flange shall be installed between each water closet and the soil pipe, gas and watertight, with non-hardening putty.

2.4 PLUMBING FIXTURES

- A. Description: See Plumbing Equipment Schedule and/or notes on plans for fixture types and accessories.
- B. Manufacturers: The following are approved equals:
 - 1. Sinks
 - a. Elkay.
 - b. American Standard Plumbing.
 - c. Eljer Plumbingware.
 - d. Kohler Co.
 - e. Sloan.
 - f. TOTO USA
 - 2. Bottle Fillers
 - a. Elkay.
 - b. Halsey Taylor.
 - c. Haws.
 - d. Sloan.
 - e. Oasis.
 - 3. Service Sinks
 - a. E.L. Mustee.
 - b. Advanced Tabco.
 - c. American Standard Plumbing.
 - d. Fiat.
 - e. Florestone.
 - f. Kohler Co.
 - g. Zurn.
 - 4. Flush Valve Water Closets
 - a. Kohler Co.
 - b. American Standard Plumbing.
 - c. Sloan.
 - d. Eljer Plumbingware.
 - e. TOTO USA.
 - 5. Drinking Fountains
 - a. Elkay.
 - b. Halsey Taylor.
 - c. Haws.
 - d. Sloan.
 - e. Oasis.
 - 6. Urinals
 - a. Kohler Co.
 - b. American Standard Plumbing.

- c. Sloan.
- d. Eljer Plumbingware.
- e. TOTO USA.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify electric power is available and of correct characteristics.
- C. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. All fixtures shall be installed to meet manufacturer's recommendations and local codes.
- B. Unless otherwise noted, fixture rough-in shall be at heights shown within contract documents, or if not within contract documents, as recommended by manufacturer. Note special rough-in requirements for handicapped persons' fixtures.
- C. An exposed stop valve shall be installed on each supply to each fixture connection. This includes such items as water fountains and rough-in provisions for ice makers, vending machines, etc. Stops shall be located in an accessible location behind or below the fixture serviced, otherwise in branch piping as approved.
- D. Install fixtures complete with all necessary items such as carriers, plates, bolts, and escutcheons. Floor mounted fixtures shall have china bolt caps.
- E. Escutcheons shall be installed on piping at all wall penetrations. Escutcheons shall seat tight to the wall.
- F. All wall-hung fixtures shall be securely supported by a carrier designed for the specific fixture and mounted tight to wall. The contractor shall provide adequate blocking, reinforcing and stiffening of plumbing wall to adequately support the fixture or wall support. Fixture installation which causes deflection of the wall will require reopening of the wall and re-support of the fixture. Wall hangers are not acceptable.
- G. Set floor and roof drains in place, level and at proper elevation for drainage specified.
- H. Use sealing compound Dow #784 white silicone sealant, or approved equal, for the following installations:
 - 1. Rims and trim of stainless steel sinks.
 - 2. Between the wall and the adjoining edge(s) of mop sinks.
- I. Adjust faucets, operating hardware, and flush valves for specified flow. Test all tailpieces, traps, supplies, and faucets for leaks.
- J. Install safety covers to comply with the ADA where required.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 ADJUSTING

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for testing, adjusting, and balancing.
- B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for final cleaning.
- B. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for protecting installed construction.
- B. Do not permit use of fixtures before final acceptance.

END OF SECTION

SECTION 230500
COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Flashing.
 - 7. Escutcheons.
 - 8. HVAC demolition.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Electrical requirements for mechanical equipment
 - 11. Painting and finishing.
 - 12. Ceiling tacks.
 - 13. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct 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 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. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and 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. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 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 HVAC 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.

1.5 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.

1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC 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 HVAC 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

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 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.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. 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 thickness or specific material is indicated.
 - 2. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - 3. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 4. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

2.5 DIELECTRIC FITTINGS

- A. No dielectric unions allowed. Use threaded brass unions or threaded brass valves where dissimilar materials meet.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 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: Plastic. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 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.
- 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.

2.8 FLASHING

- A. Metal Flashing: 26-gauge-thick galvanized steel.
- B. Metal Counterflashing: 22-gauge-thick galvanized steel.

- C. Lead Flashing:
 - 1. Waterproofing: 5 lb/sq ft sheet lead.
 - 2. Soundproofing: 1 lb/sq ft sheet lead.
- D. Flexible Flashing: 47-mil-thick sheet butyl; compatible with roofing.
- E. Caps: Steel, 22-gauge minimum; 16 gauge at fire-resistant elements.

2.9 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.

2.10 CEILING TACKS

- A. Description: Steel with 3/4-inch-diameter color-coded head.
- B. Color code as follows:
 - 1. HVAC equipment: Yellow.
 - 2. Heating/cooling valves: Blue.

2.11 ELECTRICAL INSTALLATION REQUIREMENTS

- A. Electrical installations must conform to IEEE C2, NFPA 70, and requirements specified herein.
- B. New Work:
 - 1. Provide electrical components of mechanical equipment, such as motors, motor starters, control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment.
 - 2. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, and the electrical power circuits must be provided under Division 26, except internal wiring for components of package equipment must be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.
- C. Modifications to Existing Systems: Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components under Division 26.
- D. High Efficiency Motors:
 - 1. High Efficiency Single-Phase Motors. Unless otherwise specified, single-phase fractional-horsepower alternating-current motors must be high efficiency types corresponding to the applications listed in NEMA MG 11.
 - 2. High Efficiency Polyphase Motors. Unless otherwise specified, polyphase motors must be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings must meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.
 - 3. Three-Phase Motor Protection. Provide controllers for motors rated one 1 horsepower and larger with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

PART 3 EXECUTION

3.1 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 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 and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. 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.
 - 3. Install sleeves in new walls and slabs as new walls and slabs are constructed.

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.
- N. Verify final equipment locations for roughing-in.
- O. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 3. 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.
 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.4 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.

3.5 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 HVAC 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.
- E. Provide ceiling tacks to locate equipment, valves or dampers above T-bar-type panel ceilings. Locate in corner of panel closest to equipment.

3.6 INSTALLATION – FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.
- C. Provide curbs for roof installations 14 inches minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing to equipment and lap base flashing on roof curbs. Flatten and solder joints.
- D. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

END OF SECTION

SECTION 230503
PIPES AND TUBES FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. This Section includes pipe and pipe fittings for the following systems:
 - 1. Heating water piping.
 - 2. Chilled water piping.
 - 3. Steam and condensate piping.
 - 4. Equipment drains and overflows.
 - 5. Unions and flanges.

1.2 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.

1.3 QUALITY ASSURANCE

- A. Perform work in accordance with ASME B31.1 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- B. All steel pipe shall be domestic, no foreign steel piping.
- C. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
 - 1. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.
 - 2. Gaskets shall be molded and produced by the coupling manufacturer and shall be suitable for the intended service.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.5 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.6 COORDINATION

- A. Refer to Section, ADMINISTRATIVE REQUIREMENTS for requirements for coordination.
- B. Coordinate installation of buried piping with trenching.

PART 2 – PRODUCTS

2.1 HEATING WATER PIPING, ABOVE GROUND

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black.
 - 1. Fittings: ASME B16.3, malleable iron or ASTM A234/A234M, forged steel welding type.
 - 2. Joints: Threaded for pipe 2 inches and smaller; welded for pipe 2-1/2 inches and larger.

- B. Steel Pipe: ASTM A53/A53M, Schedule 40, black, cut grooved ends.
 - 1. Fittings: ASTM A395/A395M and ASTM A536 ductile iron, or ASTM A234/A234M carbon steel, grooved ends.
 - 2. Joints: Grooved mechanical couplings meeting ASTM F1476.
 - 3. Housing Clamps: ASTM A395/A395M and ASTM A536 ductile iron, enamel coated, compatible with steel piping sizes, rigid or flexible type.
 - 4. Gasket: Elastomer composition for operating temperature range from -30 degrees F to 230 degrees F.
 - 5. Accessories: Steel bolts, nuts, and washers.
- C. Copper Tubing: ASTM B88, Type L, hard drawn.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
 - 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 degrees F to 535 degrees F.

2.2 CHILLED WATER PIPING, ABOVE GROUND

- A. Copper Tubing, 3" and smaller: ASTM B88, Type L, hard drawn.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
 - 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 degrees F to 535 degrees F.
- B. Schedule 80 PVC, 4" and larger.

2.3 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized.
 - 1. Fittings: ASME B16.3, malleable iron or ASME B16.4, cast iron.
 - 2. Joints: Threaded for pipe 2 inches and smaller; flanged for pipe 2-1/2 inches and larger.
- B. Copper Tubing: ASTM B88, Type L, hard drawn.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
 - 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 degrees F to 535 degrees F.
- C. PVC Pipe: Air conditioning condensate drains only, ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26, polyvinyl chloride (PVC) material.
 - 1. Fittings: ASTM D2466, Schedule 40, PVC.
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.4 LOW-PRESSURE STEAM PIPING, ABOVE GROUND (15 PSIG MAXIMUM)

- A. Steel Pipe: ASTM A53/A53M, Schedule 80, black.
 - 1. Fittings: ASME B16.3 cast iron Class 125.
 - 2. Joints: Threaded for pipe 2-1/2 inches and smaller; welded for pipe 3 inches and larger.

2.5 LOW-PRESSURE STEAM CONDENSATE PIPING, ABOVE GROUND

- A. Steel Pipe: ASTM A53/A53M, Schedule 80, black.
 - 1. Fittings: ASME B16.3 cast iron Class 125.
 - 2. Joints: Threaded for pipe 2-1/2 inches and smaller; welded for pipe 3 inches and larger.

2.6 UNIONS AND FLANGES

- A. Unions For Pipe 2 Inches and Smaller:
 - 1. Ferrous Piping: Class 150, cast iron, threaded.
 - 2. Copper Piping: Class 150, bronze unions with soldered.
 - 3. PVC Piping: PVC.
 - 4. CPVC Piping: CPVC.

- B. Flanges for Pipe 2-1/2 Inches And Larger:
 - 1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
 - 2. Gaskets: 1/16-inch-thick preformed neoprene gaskets.
- C. Grooved Joint Couplings:
 - 1. Steel Piping:
 - 2. Rigid Type: Coupling housings shall be cast with offsetting, angle-pattern bolt pads to provide joint rigidity and support and hanging in accordance with ANSI B31.1 and B31.9.
 - a. Victaulic Style 107H, Installation-Ready, for direct stab installation without field disassembly, with grade EHP gasket, suitable for water service to +250 deg F.
 - b. Victaulic Style 07 "Zero-Flex".
 - 3. Flexible Type: For use in locations where vibration attenuation and stress relief are required, and for the elimination of flexible connectors. Victaulic Installation-Ready Style 177 or Style 77.
- D. PVC Pipe Materials: For connections to equipment and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or ASTM D2464, Schedule 80, threaded, PVC pipe.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Refer to Section, ADMINISTRATIVE REQUIREMENTS for verification of existing conditions before starting work.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - ABOVE GROUND PIPING

- A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- C. Group piping whenever practical at common elevations.
- D. Sleeve pipe passing through partitions, walls, and floors.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
 - 1. For water systems, Victaulic flexible couplings may be used on header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops (as approved by the engineer). Where loops are required, use flexible-type couplings on the loops.
- F. Grooved joint shall be installed in accordance with the manufacturer's written recommendations. Grooved ends shall be clean and free from indentations, projections, or roll marks. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service. The coupling manufacturer's factory trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. (A distributor's representative is not considered qualified to conduct the training.)

- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- I. Provide access where valves and fittings are not accessible.
- J. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- K. Slope piping and arrange systems to drain at low points.
- L. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- M. Install piping penetrating roofed areas to maintain integrity of roof assembly.

3.4 INSTALLATION – HEATING AND COOLING PIPING SYSTEMS

- A. Install heating water and chilled water piping in accordance with ASME B31.1.
- B. Install steam supply and steam condensate return piping in accordance with ASME B31.1.

3.5 FIELD QUALITY CONTROL

- A. Test piping systems in accordance with ASME B31.9.

3.6 CLEANING

- A. After completion, fill, clean, and treat piping systems. Refer to Section, HVAC WATER TREATMENT.

END OF SECTION

SECTION 230523
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. This Section includes:
 - 1. Gate valves.
 - 2. Globe valves.
 - 3. Ball valves.
 - 4. Plug valves.
 - 5. Butterfly valves.
 - 6. Check valves.

1.2 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal requirements.
- B. Product Data: Submit manufacturer's catalog information with valve data and ratings for each service.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.3 QUALITY ASSURANCE

- A. Single-Source Responsibility: Comply with the requirements specified in Section, MATERIALS AND EQUIPMENT, under SOURCE LIMITATIONS Article.
- B. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the various MSS Standard Practices referenced.

1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for submittal requirements.
- B. Project Record Documents: Record actual locations of valves.
- C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

- A. Apollo
- B. Crane
- C. Hammond
- D. Milwaukee
- E. NIBCO
- F. Stockham

2.2 VALVE FEATURES, GENERAL

- A. Valve Design: Rising stem or rising outside screw and yoke stems.

1. Non-rising stem valves may be used where headroom prevents full extension of rising stems.
- B. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.
- C. Sizes: Same size as upstream pipe, unless otherwise indicated.
- D. Operators: Provide the following special operator features:
 1. Handwheels, fastened to valve stem, for valves other than quarter turn.
 2. Lever handles, on quarter-turn valves 6 inches and smaller, except for plug valves. Provide plug valves with square heads; provide 1 wrench for every 10 plug valves.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.
- G. End Connections: As indicated in the valve specifications.
 1. Threads: Comply with ANSI B1.20.1.
 2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.

2.3 GATE VALVES

- A. All Gate Valves: On-off service only, no throttling duty.
- B. Gate Valves, 2 Inches and Smaller: MSS SP-80; Class 125, body and bonnet of ASTM B62 cast bronze; with threaded ends, solid disk, copper-silicon alloy stem, brass packing gland, Teflon-impregnated packing, and malleable iron handwheel. Provide Class 150 valves meeting the above where system pressure requires.
- C. Gate Valves, 2-1/2 Inches and Larger: MSS SP-70; Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A126 Class B; with flanged ends, Teflon-impregnated packing, and two-piece backing gland assembly.

2.4 GLOBE VALVES

- A. All globe valves; for throttling duty only; no shutoff. Flow direction arrow cast into valve body.
- B. Use Buna-N disk for water, oil, and gas services. Use Teflon disk for steam services.
- C. Globe Valves, 2 Inches and Smaller: MSS SP-80; Class 125; body and screwed bonnet of ASTM B62 cast bronze; with threaded, brass or replaceable composition disk, copper-silicon alloy stem, brass packing gland, Teflon-impregnated packing, and malleable iron handwheel. Provide Class 150 valves meeting the above where system pressure requires.
- D. Globe Valves, 2-1/2 Inches and Larger: MSS SP-85; Class 125 iron body and bolted bonnet conforming to ASTM A126, Class B; with outside screw and yoke, bronze mounted, flanged ends, and Teflon-impregnated packing, and two-piece backing gland assembly.

2.5 BALL VALVES

- A. All ball valves, for both throttling and shutoff duty. Full-flow port, 90-degree on-off operation.
- B. Ball Valves, up to 2-Inch Size: Rated for 150 psi saturated steam pressure, 600 psi WOG pressure; two-piece construction; threaded ends; with bronze body conforming to ASTM B584, full port, stainless steel ball, replaceable Teflon or "TFE" seats and seals, blowout proof stem, separate adjustable packing nut, and vinyl-covered steel handle.

2.6 PLUG VALVES

- A. Plug Valves, 2 Inches and Smaller: Rated at 150 psi WOG; bronze body, with straightaway pattern, square head, and threaded ends.
- B. Plug Valves, 2-1/2 Inches and Larger: MSS SP-78; rated at 175 psi WOG; lubricated plug type, with semi-steel body, single gland, wrench operated, and flanged ends.

2.7 BUTTERFLY VALVES

- A. 2-1/2 Inches and Larger: MSS SP-67, Class 200.
 - 1. Body: ductile iron, lug style stainless steel stem, extended neck.
 - 2. Disk: aluminum bronze.
 - 3. Seat: Resilient replaceable EPDM.

2.8 CHECK VALVES

- A. Swing Check Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 200, cast-bronze body and cap conforming to ASTM B62; with horizontal swing or Y pattern, and bronze disk; and having threaded ends.
- B. Swing Check Valves, 3 Inches and Larger: MSS SP-71; Class 200, cast iron body and bolted cap conforming to ASTM A126, Class B; horizontal swing, and bronze disk with bronze disk ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install valves with clearance for installation of insulation and allowing access.
- D. Provide access where valves and fittings are not accessible.

3.2 VALVE ENDS SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 - 1. Copper Tube Size, 2 Inches and Smaller: threaded ends.
 - 2. Steel Pipe Sizes, 2 Inches and Smaller: Threaded or grooved end.
 - 3. Steel Pipe Sizes, 2-1/2 Inches and Larger: Grooved end or flanged.

3.3 VALVE APPLICATIONS

- A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves and unions for each item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.
- D. Install three-valve bypass around each pressure reducing valve using throttling-type valves.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.

END OF SECTION

SECTION 230529
HANGERS AND SUPPORTS FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. This Section includes:
 - 1. Pipe hangers and supports.
 - 2. Duct hangers and supports.
 - 3. Hanger rods.
 - 4. Inserts.

1.2 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
- C. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.

1.3 QUALITY ASSURANCE

- A. Perform work in accordance with applicable authority for welding hanger and support attachments to building structure.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Hydronic Piping:
 - 1. Conform to MSS SP 58 and MSS SP 69.
 - 2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron or carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Cold Pipe Sizes 2 Inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Carbon steel, adjustable, clevis.
 - 5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 6. Wall Support for Pipe Sizes 3 Inches and Smaller: Cast iron hooks.
 - 7. Wall Support for Pipe Sizes 4 Inches and Larger: Welded steel bracket and wrought steel clamp.
 - 8. Vertical Support: Steel riser clamp.
 - 9. Copper Pipe Support: Copper-plated, carbon steel ring.
- B. Refrigerant Piping:
 - 1. Conform to MSS SP58.
 - 2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron or carbon steel, adjustable swivel, split ring.
 - 3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 4. Vertical Support: Steel riser clamp.
 - 5. Copper Pipe Support: Copper-plated carbon-steel ring.

2.2 DUCT HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. 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.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.3 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.4 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Refer to Section, ADMINISTRATIVE REQUIREMENTS for verification of existing conditions before starting work.

3.2 PREPARATION

- A. Do not drill or cut structural members.

3.3 INSTALLATION – INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below, and provide through-bolt with recessed square steel plate and nut above slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with MSS SP 58.
- B. Support horizontal piping per mechanical code or MSS SP 69.
- C. Install hangers with minimum 1/2-inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2-inch-minimum vertical adjustment.
- F. Support vertical piping at every floor.

- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation.

3.5 INSTALLATION – DUCT HANGERS AND SUPPORTS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "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 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "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 intervals 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.

END OF SECTION

SECTION 230548
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Freestanding and restrained spring isolators.
 - 5. Housed spring mounts.
 - 6. Elastomeric hangers.
 - 7. Spring hangers.
 - 8. Spring hangers with vertical-limit stops.
 - 9. Pipe riser resilient supports.
 - 10. Resilient pipe guides.
 - 11. Seismic restraint assemblies.
 - 12. Restraining braces and cables.

1.3 DEFINITIONS AND STANDARDS

- A. Referenced Standards
 - 1. ACSE 7-10: American Society of Civil Engineers / Structural Engineering Institute Standard 7-10, Minimum Design Loads for Buildings and Other Structures.
- B. Design Criteria:
 - 1. Occupancy Category: ASCE 7-10 Occupancy Category designation, Table 1-1
 - 2. Site Classification: ASCE 7-10 Site Classification designation, Table 20.3-I
 - 3. Peak Spectral Response Acceleration (SS): ASCE 7-10 Figure 22-1 – Maximum Considered Earthquake Ground Motion of 0.2s spectral response acceleration, Site Class B
 - 4. Design Spectral Response Acceleration (SDS): ASCE 7-10, Eqs. 11.4-1 and 11.4-3
 - 5. Seismic Design Category: ASCE 7-10 Seismic Design Category designation, Tables 11.6-I and II.6-2.
 - 6. Component Importance Factor (IP): ASCE 7-10, Section 13.1.3
- C. Custom Engineered Assembly: Anchorage and seismic restraint assembly, comprised of standard or proprietary components, designed and applied to system by the Seismic Engineer.
- D. Pre-Engineered Assembly: Previously designed anchorage and seismic restraint assembly selected and applied to system by the Seismic Restraint System Engineer.
- E. Seismic Restraint System Engineer: Registered Professional Engineer currently licensed in Oregon as a structural, civil, or mechanical engineer. Responsible for designing, applying, and inspecting pre-engineered seismic restraint assemblies and components in accordance with applicable codes and component manufacturer's published recommendations.

- F. Seismic Engineer: Professional engineer currently licensed in Oregon as a structural, civil, or mechanical engineer. Responsible for designing, applying, and inspecting custom seismic restraint components in accordance with applicable codes.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: C.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.
 - 3. Component Importance Factor: 1.25.
 - 4. Component Response Modification Factor: per ASCE 7.
 - 5. Component Amplification Factor: per ASCE 7.

1.5 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 by 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.
- B. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- C. Field quality-control test reports.

1.6 SEISMIC SYSTEM ENGINEERING AND QUALITY ASSURANCE

- A. Seismic restraint system shall be engineered to comply with criteria stated and referenced herein.
- B. Seismic restraints and related engineering for HVAC systems to be provided by a single vendor.
- C. Application of Pre-engineered Assemblies by Seismic Restraint System Engineer:
 - 1. Application of Custom Engineered and/or Pre-Engineered Assemblies, as applicable to this project, and as follows:
 - a. Application of restraints for floor or roof-mounted equipment.
 - b. Application of restraints for curb mounted equipment including unit-to-curb and curb-to-structure attachments.
 - c. Application of seismic restraint assemblies for vibration isolated and suspended equipment.
 - 2. Application of seismic restraint assemblies for piping and ductwork.
 - a. Submittal packages shall bear the stamp of only the responsible Seismic Restraint System Engineer.
 - b. Approved Pre-engineered Assembly and Application Services: Mason Industries, Kinetics, or an independent professional engineer meeting qualifications listed herein as Seismic Restraint System Engineer.

- D. Custom Engineered Assemblies:
 - 1. System engineering shall include design and application of Custom Engineered Assemblies, as applicable to this project, and as follows:
 - a. Design and Application of restraints for floor or roof-mounted equipment.
 - b. Design and Application of restraints for curb mounted equipment including unit-to-curb and curb-to-structure attachments.
 - c. Design and Application of seismic restraint assemblies for vibration isolated and suspended equipment.
 - d. Design and Application of seismic restraint assemblies for piping and ductwork.
 - 2. Engineering shall be performed by, or under the direct supervision of, a Seismic Engineer meeting the qualifications listed herein. Submittal packages shall bear the signed seal of only the Seismic Engineer.
- E. Lateral loads and anchorage requirements at attachment to building structural system to be coordinated with project Structural Engineer.
- F. 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.

1.7 SHOP DRAWINGS, PRODUCT DATA, OPERATION & MAINTENANCE DATA

- A. Pre-submittal:
 - 1. Submit attached letter (at end of this section) outlining how the seismic requirements for this project will be met (i.e., Pre-engineered Assemblies, Custom Assemblies). In the letter state what companies will be providing the services and the qualifications of the responsible individuals.
- B. Shop drawings shall be submitted as one complete package inclusive of all mechanical systems and equipment.
- C. Submit the following in accordance with Section, SUBMITTAL PROCEDURES:
 - 1. Seismic Restraint Location Plan: Full or half size copies of ductwork and piping plans from the Contract Documents, showing locations and type of seismic restraint assemblies to be used.
 - a. Drawings shall consist of mechanically reproduced copies of the Contract Documents, or custom drafted specifically for the Work of this Project and bear only the seal of the Seismic Restraint System Engineer or Seismic Engineer. All other seals shall be removed from drawings prior to submittal.
 - b. Provide separate drawings for ductwork and piping systems.
 - c. Each drawing shall be printed on a single sheet. Drawings pieced together from multiple copies are not acceptable.
 - 2. Seismic Restraint Assembly Installation Details: Pre-Engineered or Custom Engineered assembly details showing required components, dimensions, and method of connection to supporting structure.

3. Calculations for System Application: Calculations shall indicate maximum forces anticipated at each restraint assembly, method of determining forces, and selection of restraint assemblies.
 - d. For Pre-Engineered Assemblies, include documentation of design conditions, maximum load capacity of assembly, and maximum forces at anchorage points.
 - e. For Custom Engineered Assemblies, submit calculations identifying maximum load capacity of assembly, maximum forces on each component, sizing/selection of each component, and maximum forces at anchorage points.
- D. The entire submittal package comprised of drawings, details, and calculations for mechanical ductwork, piping, and equipment shall be stamped and signed in accordance with the requirements listed under Article, SEISMIC SYSTEM ENGINEERING AND QUALITY ASSURANCE in this specification section.
- E. At seismic restraint system installation completion, submit three (3) copies of report from seismic restraint system Engineer, or the Engineer's representative, certifying that seismic restraints are installed in conformance with approved shop drawings and no additional restraints are necessary based on field conditions. Include written authorization, from Seismic Restraint System Engineer, of the designated representative.
- F. Prior to Contract Closeout submit Operation and Maintenance information required as indicated in Section, CLOSEOUT PROCEDURES.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amber/Booth Company, Inc.
 2. CalDyn / California Dynamics Corporation.
 3. Kinetics Noise Control.
 4. Mason Industries.
 5. Vibration Eliminator Co., Inc.
 6. Vibro-Acoustics
 7. The VMC Group
- B. Pads: Arranged 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.
- C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

- D. Restrained Mounts: All-directional mountings with seismic restraint.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- 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-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 - 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-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.
- G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
 - 1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 - 2. Base: Factory drilled for bolting to structure.
 - 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.
- H. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- I. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 - 1. 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.

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. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- J. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. 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.
 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. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- K. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch-thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- L. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch-thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 SEISMIC-RESTRAINT DEVICES

- A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by 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.
- B. Pre-Engineered Assemblies
1. Anchorage and seismic restraint assemblies comprised of standard or proprietary components, capable of application to restraint system and supporting structure.

2. Acceptable Proprietary Manufacturers: Mason Industries, Kinetics, Tolco, B-Line, or approved.

PART 3 EXECUTION

3.1 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.

3.2 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Comply with requirements in Section, ROOF ACCESSORIES for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
- C. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- D. 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.
- E. 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.
- F. 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.

3.3 SEISMIC RESTRAINT INSTALLATION

- A. General
 1. Seismic restraint system shall be installed in strict accordance with the manufacturer's written instructions and certified submittal data.

2. Conflicts with other trades that result in rigid contact with the equipment or piping due to inadequate space or other conditions shall be coordinated with the Seismic Restraint Engineer and corrected.
 3. Attach restraints and anchors to a common structural element plane and within a common structural system.
 4. For vibration isolated suspended equipment, piping, and ducts, install flexible cable restraints slightly slack to avoid vibration short circuiting.
 5. For non-isolated suspended equipment, piping, and ducts, install solid braces or taut flexible cable restraints.
 6. Provide supplementary support steel for equipment, piping, and ductwork required for the work of this Section.
- B. Equipment Seismic Restraint
1. Coordinate size of housekeeping pads and/or concrete piers to ensure adequate space for required bases, isolators, restraints, and attachment thereto.
- C. Ductwork and Piping Seismic Restraint
1. Provide minimum of two transverse supports and one longitudinal support on each pipe or duct run. Transverse bracing shall be installed at each turn and at each end of a run with a minimum of one brace at each end. Where a pipe or duct run is shorter than the minimum interval between braces, provide braces at each end.
 2. Where restraints are attached to clevis style pipe hangers, the cross bolt must be reinforced.
- D. Equipment with Vibration Isolation Supports
1. Anchor isolator to structural system in accordance with details on Drawings and isolator manufacturer's instructions.
- E. Piping with Vibration Isolation Supports
1. Seismic restraints for vibration isolated piping shall be installed to restrict excessive lateral, vertical, and longitudinal motion without providing support or rigid contact between piping and structure during normal operation.

3.4 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, HYDRONIC PIPING for piping flexible connections.

3.5 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.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 230548 - SEISMIC RESTRAINT SYSTEM ENGINEERING PRE-SUBMITTAL

PROJECT: _____
(Project Title)

The Undersigned states the following:

- Seismic restraints for the work of Division 23 for this project will be provided as required in Section 230548.
- Application of Pre-Engineered Restraint Assemblies will be provided by Seismic Restraint System Engineer meeting qualifications of Section 230548.

Seismic Restraint System Engineer: _____

Firm Name: _____

Authorized Representative: _____
(Name of representative authorized to act on Engineer's behalf)

- Design for Custom Engineered Restraint Assemblies will be provided by Seismic Engineer meeting qualifications of Section 230548.

Seismic Engineer: _____

Firm Name: _____

Authorized Representative: _____
(Name of representative authorized to act on Engineer's behalf)

- Upon completion of seismic restraint system installation the Engineers listed above, or the designated representative listed, will inspect and certify that seismic restraints are installed in conformance with approved shop drawings and, based on actual field conditions, no additional restraints are necessary to comply with applicable codes.

Submitted by: _____ Signature: _____

Firm: _____ Date: _____

Address: _____

Telephone: _____ E-mail: _____

SECTION 230553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. This Section includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Pipe markers.
 - 4. Labels.

1.2 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Provide statement from supplier and/or installer confirming compliance with SOU Construction Standards (Division 22, Section 22 00 00 "Plumbing", Item #20). See Part 4.

1.3 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.4 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

1.5 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 MECHANICAL IDENTIFICATION MATERIALS

- A. Manufacturer:
 - 1. Allen Systems, Inc.
 - 2. Brady (W.H.) Co.; Signmark Div.
 - 3. Industrial Safety Supply Co., Inc.
 - 4. Seton Name Plate Corp.
 - 5. MSI (marketing Services, Inc.)

2.2 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved white letters on black background color.

2.3 TAGS

- A. Plastic Tags:
 - 1. Laminated three-layer plastic with engraved white letters on black background color. Tag size minimum 1-1/2 inches square.

- B. Metal Tags:
 - 1. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.
- C. Information Tags:
 - 1. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 inches x 5-5/8 inches with grommet and self-locking nylon ties.
- D. Tag Chart: Typewritten letter size list of applied tags and location, plastic laminated.

2.4 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
- B. Plastic Pipe Markers:
 - 1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- C. Plastic Tape Pipe Markers:
 - 1. Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

2.5 LABELS

- A. Description: Aluminum, polyester, or laminated Mylar, size 1.9 inches x 0.75 inch, adhesive backed with printed identification.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners or adhesive.
- C. Install labels with sufficient adhesive for permanent adhesion, and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- D. Install tags using corrosion-resistant chain. Number tags consecutively by location.
- E. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify valves in main and branch piping with brass tags.
- H. Identify air terminal units and radiator valves with numbered tags.
- I. Tag automatic controls, instruments, and relays. Key to control schematic.
- J. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers. Use tags on piping 3/4-inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- K. Identify ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

PART 4 EXCERPT FROM SOU CONSTRUCTION STANDARDS:

4.1 Minimum Identification for Building Systems:

- a. During finish construction, labeling is to be reviewed and approved by FMP.
- b. Provide permanent signage, interior and exterior, at all utility boxes, vaults, manholes, main valves, etc.

- c. Label ceilings or ceiling grid (not the tile) at key access points, valves, equipment, etc. with a clear adhesive label and bold black lettering with equipment, etc. ID information.
- d. Zoned systems must have clearly defined valves.
- e. Covering or painting of any sign/label requires replacement.
- f. No color banding.
- g. Label all valves with brass valve tags that include the following information:
 - i. Valve number (number to include piping system descriptor).
 - ii. What area of the building the valve serves (main, floor, area, room, etc).
 - iii. Valve status: normally open (OPEN) or normally closed (CLOSED).
 - iv. What piping system the valve serves.
- h. ANSI / ASME 13.1 (2007) shall be used and followed for all piping.
 - i. Pipe markers should be positioned so that they can be easily seen from the normal angle of approach.
 - ii. Labels shall include direction of flow.
 - iii. Piping labels are required at the following locations:
 - 1. Adjacent to all valves and flanges.
 - 2. Adjacent to all changes of direction.
 - 3. On both sides of wall or floor penetrations.
 - 4. At regular 20ft intervals on straight runs or increments required by code if less than 20 ft.
 - iv. Pipe diameter determines the appropriate label and text sizes as follows: Pipes too small to be directly labeled should be marked with a hanging tag.

Outside Pipe Diameter (including insulation):		Minimum Length of Label Color Field:		Minimum Letter Height:	
Inches	mm	Inches	mm	Inches	mm
0.75 – 1.25	19 - 32	8	203	0.5	13
1.5 - 2	38 - 51	8	203	0.75	19
2.5 - 6	64 - 152	12	305	1.25	32
8 - 10	203 - 254	24	610	2.5	64
>10	>254	32	813	3.5	89

i. Building Systems Labeling Standard for Piping and Valves:

Piping Labeling Standards	Valve Tag Descriptor
12# Steam	12#S
Air	AIR
Chilled Water	Supply CWS
Chilled Water	Return CWR
Cold Water	CW
Condensate	C
Condensate Return	CR
Distilled Water	DW
Heat Recovery Supply	HRS
Heat Recovery Return	HRR
Hot Water Supply	HWS
Hot Water Recirculated	HWR
Hot Water Heating Supply	HWHS
Hot Water Heating Return	HWHR
Lab Vent	Lab Vent
Lab Waste	Lab Waste
Natural Gas	GAS
Refrigeration Compressor Discharge	RCD
Refrigeration Compressor Suction	RCS
Roof Drain	RD
Solar Water Heating Supply	SWHS
Solar Water Heating Return	SWHR
Vent	VENT
Waste, Gravity	WASTE
Waste, Pumped	WASTE - PUMPED

END OF SECTION

SECTION 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. This Section includes:
 - 1. Testing, adjusting, and balancing of air systems.
 - 2. Testing, adjusting, and balancing of hydronic and steam systems.
 - 3. Measurement of final operating condition of HVAC systems.

1.2 REFERENCES

- A. Associated Air Balance Council:
 - 1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
 - 1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.3 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Test Reports: Indicate data on AABC MN-1 National Standards for Total System Balance forms or NEBB Report forms.
- C. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- D. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms, and copy of AABC National Project Performance Guaranty or copy of NEBB Certificate of Conformance Certification.
- E. Submit draft copies of report for review prior to final acceptance of Project.
- F. Furnish reports in binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced Drawings with air outlets and equipment identified to correspond with datasheets and indicating thermostat locations.

1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for closeout procedures.
- B. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
- B. Prior to commencing work, calibrate each instrument to be used.

1.6 QUALIFICATIONS

- A. Test and Balance Engineer's Qualifications: A Professional Engineer (either on the installer's staff or an independent consultant), registered in the State in which the services are to be performed, and having at least 3-years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this Project.
- B. Agency Qualifications:
 - 1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement, and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and recording and reporting the results.
 - 2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) or the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this Project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB or AABC as a Test and Balance Engineer.

1.7 SCHEDULING

- A. Refer to Section, ADMINISTRATIVE REQUIREMENTS for coordination and project conditions.
- B. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
- C. Test, adjust, and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5 degrees. F wet bulb temperature of maximum summer design condition, and within 10 degrees. F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.
- D. Schedule and provide assistance in final adjustment and test of life safety system with Fire Authority.

PART 2 PRODUCTS

2.1 Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Refer to Section, ADMINISTRATIVE REQUIREMENTS, for coordination and Project conditions.
- B. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.

7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed, and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place or in normal position.
15. Service and balancing valves are open.

3.2 PREPARATION

- A. Furnish instruments required for testing, adjusting, and balancing operations.

3.3 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10% of design.
- B. Air Outlets and Inlets: Adjust total to within plus 10% and minus 5% of design to space. Adjust outlets and inlets in space to within plus or minus 10% of design.
- C. Hydronic Systems: Adjust to within plus or minus 10% of design.

3.4 ADJUSTING

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS, [for testing, adjusting, and balancing.
- B. Verify recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- E. Report defects and deficiencies noted during performance of services, preventing system balance.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross-sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.
- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50% loading of filters.

- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05-inch positive static pressure near building entries.
- M. For variable air volume system powered units set volume controller to airflow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable-air-volume temperature control.

3.6 WATER SYSTEM PROCEDURE

- A. Adjust water systems, after air balancing, to obtain design quantities.
- B. Use calibrated fittings and pressure gauges to determine flow rates for system balance. Where flowmetering devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.
- C. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open or in normal position to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shutoff valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, simulate full flow in one part by temporary restriction of flow to other parts.

3.7 PROJECT CLOSEOUT

- A. Some system balancing and adjusting will be for comfort. Accordingly, Contractor shall allow for readjusting air quantities or other settings after building completion and occupancy, for user comfort rather than conformance to indicated design values.

3.8 SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing:
 - 1. Plumbing Pumps.
 - 2. HVAC Pumps.
 - 3. Air Coils.
 - 4. Air Handling Units.
 - 5. Fans.
 - 6. Air Terminal Units.
 - 7. Air Inlets and Outlets.
 - 8. Heat Exchangers.

END OF SECTION

SECTION 230700 HVAC INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. This Section includes:
 - 1. Piping insulation, jackets, and accessories.
 - 2. Equipment insulation and covering.
 - 3. Ductwork insulation and jackets.
 - 4. Internal ductwork insulation (duct liner).

1.2 SUBMITTALS

- A. Product Data: Submit product description, list of materials, and thickness for each service or equipment scheduled and locations.
- B. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.
- C. Manufacturer's Installation Instructions: Submit manufacturer's installation instructions for each product type.

1.3 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.
- B. Energy Efficiency: Insulate piping and ductwork in accordance with the Oregon Energy Efficiency Specialty Code.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Do not install insulation and related products when ambient temperatures and conditions are not meeting manufacturer's requirements.
- B. Maintain temperature before, during, and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 INSULATION

- A. Manufacturer:
 - 1. Armacell
 - 2. Certainteed Corp.
 - 3. Ductmate Industries (duct liner only)
 - 4. Johns Manville Insulations.
 - 5. Knauf Insulation
 - 6. Owens Corning Fiberglas Corp.

2.2 PIPE INSULATION

- A. Man Made Mineral Fiber: ASTM C547; rigid molded, non-combustible.
 - 1. k (ksi) factor: 0.24 at 75 degrees F.
 - 2. Maximum service temperature: 850 degrees F.
 - 3. Vapor Retarder Jacket: White Kraft paper with glass fiber yarn and bonded to aluminized film, secured with self-sealing longitudinal laps and butt strips, or with outward clinch expanding staples and vapor retarder mastic.
- B. Closed cell elastomeric: ASTM C534; flexible, cellular elastomeric, molded or sheet.

1. k (ksi) Value: 0.27 at 75 degrees F.
 2. Maximum Service Temperature: 220 degrees F.
 3. Connection: Waterproof vapor retarder adhesive.
- C. Jackets:
1. PVC Plastic: One-piece molded type fitting covers and sheet material, off-white color.
 - a. Thickness: 10 mil.
 - b. Connections: Brush on welding adhesive.

2.3 EQUIPMENT INSULATION

- A. Flexible Mineral Fiber Blanket: ASTM C553; flexible, non-combustible.
1. k (ksi) factor: 0.25 at 75 degrees F.
 2. Maximum service temperature: 250 degrees F.
 3. Density: 2.0 lb/cu ft density.
 4. Vapor Retarder Jacket: Kraft paper with glass fiber yarn and bonded to aluminized film, secured with self-sealing longitudinal laps and butt strips, or with outward clinch expanding staples and vapor retarder mastic.

2.4 DUCTWORK INSULATION

- A. Flexible Glass Fiber: ASTM C553; flexible, non-combustible blanket.
1. k (ksi) Value: 0.29 at 75 degrees F.
 2. Vapor Retarder Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, secured with pressure-sensitive tape.
- B. Rigid Glass Fiber: ASTM C612; rigid, non-combustible blanket.
1. k (ksi) Value: 0.29 at 75 degrees F.
 2. Density: 3.0 lb/cu ft.
 3. Vapor Retarder Jacket: Kraft paper with glass fiber yarn and bonded to aluminized film, secured with pressure-sensitive tape.
- C. Cellular Foam: ASTM C518 or ASTM C177; flexible, cellular elastomeric, molded or sheet.
1. k (ksi) factor: 0.25 at 75 degrees F.
 2. Maximum service temperature: 220 degrees F.
- D. Reflective Insulation: ASTM C518; flexible blanket (bubble wrap).
1. Maximum service temperature: 180 degrees F.
- E. Duct Liner:
1. Fibrous-Glass Duct Liner: ASTM C1071; flexible, noncombustible blanket.
 - a. 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.
 - b. k (ksi) Value: 0.27 at 75 degrees F.
 - c. Adhesive: Waterproof fire-retardant type.
 - d. Liner Fasteners: Galvanized steel, self-adhesive pad or welded with press-on head.
 2. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify piping, equipment, and ductwork are tested and ready for installation.

3.2 INSTALLATION

- A. Install duct liner in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and manufacturer's instructions.

- B. Continue insulation vapor barrier through penetrations.
- C. Piping Insulation:
 - 1. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
 - 2. Locate insulation, and cover seams in least visible locations.
 - 3. Neatly finish insulation at supports, protrusions, and interruptions.
 - 4. Insulate complete system of pipes conveying fluids below ambient temperature.
 - 5. Install fiberglass insulated pipes conveying fluids below ambient temperature with vapor barrier jackets. Finish with glass cloth and vapor barrier adhesive.
 - 6. For man-made mineral fiber insulated pipes conveying fluids above ambient temperature, install standard jackets. Bevel and seal ends of insulation at equipment, flanges, and unions.
 - 7. Install insert between support shield and piping on piping 2 inches in diameter or larger. Fabricate of cork or other high-density insulating material suitable for temperature, not less than 6 inches long.
 - 8. For pipe exposed in mechanical equipment rooms or in finished spaces, finish with PVC jacket and fitting covers.
 - 9. Insulation Omitted: Omit insulation on hot piping within radiation enclosures or unit cabinets; on cold piping within unit cabinets provided piping is located over drain pan; on heating piping beyond control valve, located within heated space; on condensate piping between steam trap and union; and on unions, flanges, strainers, flexible connections, and expansion joints.
- D. Equipment Insulation:
 - 1. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
 - 2. Apply insulation to equipment by grooving, scoring, and beveling insulation. Secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
 - 3. Fill joints, cracks, seams, and depressions with bedding compound to form uniform surface. On cold equipment, use vapor barrier cement.
 - 4. For fiberglass-insulated equipment containing fluids above ambient temperature, install standard jackets, with or without vapor barrier.
 - 5. Cover insulation with metal mesh and finish with coat of insulating cement.
 - 6. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around nameplates or stamps.
 - 7. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning, install insulation in to allow removal and replacement without damage.
- E. External Ductwork Insulation:
 - 1. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
 - 2. For insulated ductwork conveying air below ambient temperature, install vapor barrier jacket. Finish with tape. Seal vapor barrier penetrations with vapor barrier adhesive.
 - 3. For insulated ductwork conveying air above ambient temperature, install with or without standard vapor barrier jacket. Where service access is required, bevel and seal ends of insulation.
 - 4. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 5. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging.

F. Duct Liner:

1. Duct Lining shall be applied in strict accordance with the latest edition of SMACNA's "HVAC Duct Construction Standard Metal & Flexible" and NAIMA's "Fibrous Glass Duct Liner Standard".
2. Length of mechanical fasteners shall be selected in accordance with the manufacturer's recommendation as listed on each product. Mechanical fasteners shall be installed perpendicular to the duct surface, and in no instance shall the pin compress the liner more than 1/8" relative to the nominal thickness of the insulation.
3. All exposed edges of the duct liner shall be coated with the factory applied edge coating or an adhesive which conforms to ASTM C 916.
4. When duct lining is applied with an adhesive, the adhesive shall be applied to the sheet metal with a 90% minimum coverage. All exposed duct liner edges not coated by the manufacturer shall be coated with the same adhesive. All rips and tears shall be repaired using this same adhesive.
5. Transverse joints shall be firmly butted with no gaps and coated with adhesive. Longitudinal corner joints shall be overlapped and compressed.
6. When air velocities are 4000 to 6000 FPM, metal nosing shall be applied to all upstream transverse edges to additionally secure the insulation.

3.3 EXISTING INSULATION REPAIR:

- A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping, and sealed over existing.

3.4 SCHEDULES

- A. Piping Insulation: Insulate the following HVAC piping systems:

1. Heating Water Supply and Return
2. Steam and Condensate Piping
3. Chilled Water Supply and Return
4. Condensate Drains
5. Makeup Water

- B. Piping Insulation Thickness. Piping shall be insulated in accordance with the following table:

Fluid Operating Temperature Range (F)	NOMINAL PIPE DIAMETER (inches)				
	<1	1 to <1-1/2	1-1/2 to <4	4 to <8	<8
Above 350	4.5"	5.0"	5.0"	5.0"	5.0"
251 to 350	3.0"	4.0"	4.5"	4.5"	4.5"
201 to 250	2.5"	2.5"	2.5"	3.0"	3.0"
141 to 200	1.5"	1.5"	2.0"	2.0"	2.0"
105 to 140	1.0"	1.0"	1.5"	1.5"	1.5"
40 to 60	0.5"	0.5"	1.0"	1.0"	1.0"
Below 40	0.5"	1.0"	1.0"	1.0"	1.5"

Notes:

- a. For piping smaller than 1-1/2" and located in partitions within conditioned spaces, reduction of these thicknesses by 1" shall be permitted, but not to a thickness of less than 1".

- C. Equipment Insulation:

1. Hot Equipment (Above Ambient Temperature):
 - a. Application Requirements: Insulate the following hot equipment:
 - 1) Heat exchangers.
 - 2) Air separators.

- b. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:
 - 3) Fiberglass: 2-inches thick, except 3-inches thick for low-pressure boilers and steam-jacketed heat exchangers.

D. Ductwork Insulation:

- 1. Insulate ductwork according to the following table:

	Exterior	Unconditioned Space and Buried Ducts
Supply & Return for Heating & Cooling	R-8	R-6
Heating Only	R-6	R-6
Cooling Only	R-8	R-6

Notes:

- a. Exposed duct in conditioned space need not be insulated unless noted otherwise.
 - b. Exterior includes attics above insulated ceilings, parking garages, and crawl spaces.
 - c. For runouts less than 10 feet in length to air terminals or air outlets, the rated R-value need not exceed R-3.5.
- 2. Line first 75 feet (minimum) of supply duct downstream of air handling unit using round duct liner.
 - 3. Line all rectangular supply duct downstream of terminal units.
 - 4. Line all rectangular return duct.
 - 5. Line or wrap all other concealed supply and return ductwork.
 - 6. Wrap exhaust duct in the attic with 1" thick insulation for condensation control.

END OF SECTION

SECTION 230800
COMMISSIONING OF HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. This Section includes:
 - 1. HVAC commissioning description.
 - 2. HVAC commissioning responsibilities.
 - 3. The commission agent/authority (CxA) will be hired directly by the owner.

1.2 COMMISSIONING DESCRIPTION

- A. HVAC commissioning process includes the following tasks:
 - 1. Testing and startup of HVAC equipment and systems.
 - 2. Equipment and system verification checks.
 - 3. Assistance in functional performance testing to verify testing and balancing, and equipment and system performance.
 - 4. Provide qualified personnel to assist in commissioning tests, including seasonal testing.
 - 5. Complete and endorse functional performance test checklists provided by Commissioning Authority to assure equipment and systems are fully operational and ready for functional performance testing.
 - 6. Provide equipment, materials, and labor necessary to correct deficiencies found during commissioning process to fulfill contract and warranty requirements.
 - 7. Provide operation and maintenance information and record drawings to Commissioning Authority for review verification and organization, prior to distribution.
 - 8. Provide assistance to Commissioning Authority to develop, edit, and document system operation descriptions.
 - 9. Provide training for systems specified in this Section with coordination by Commissioning Authority.
- B. Equipment and Systems to Be Commissioned:
 - 1. Pumps.
 - 2. Variable-frequency drives.
 - 3. Split-system (ductless) air conditioning units.
 - 4. Air handling units.
 - 5. Heat exchangers.
 - 6. Variable-volume terminal units.
 - 7. Fans.
 - 8. Equipment vibration control.
 - 9. Automatic temperature control system.
 - 10. Testing, adjusting, and balancing work.

1.3 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.
- B. Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when necessary revisions are discovered during commissioning.

1.4 COMMISSIONING RESPONSIBILITIES

- A. Equipment or System Installer Commissioning Responsibilities:
 - 1. Attend commissioning meetings.
 - 2. Ensure temperature controls installer performs assigned commissioning responsibilities as specified below.
 - 3. Ensure testing, adjusting, and balancing agency performs assigned commissioning responsibilities as specified.
 - 4. Provide instructions and demonstrations for Owner's personnel.
 - 5. Ensure subcontractors perform assigned commissioning responsibilities.
 - 6. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
 - 7. Develop startup and initial checkout plan using manufacturer's startup procedures and functional performance checklists for equipment and systems to be commissioned.
 - 8. During verification check and startup process, execute HVAC-related portions of checklists for equipment and systems to be commissioned.
 - 9. Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Authority.
 - 10. Provide manufacturer's representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments, and problem-solving.
 - 11. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
 - 12. Provide personnel to assist Commissioning Authority during equipment or system verification checks and functional performance tests.
 - 13. Prior to functional performance tests, review test procedures to ensure feasibility, safety, and equipment protection, and provide necessary written alarm limits to be used during tests.
 - 14. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.
 - 15. Provide factory-supervised startup services for equipment and systems as specified in other Sections. Coordinate work with manufacturer and Commissioning Authority.
 - 16. Perform verification checks and startup on equipment and systems as specified.
 - 17. Assist Commissioning Authority in performing functional performance tests on equipment and systems as specified.
 - 18. Perform operation and maintenance training sessions scheduled by Commissioning Authority.
 - 19. Conduct HVAC system orientation and inspection.
- B. Temperature Controls Installer Commissioning Responsibilities:
 - 1. Attend commissioning meetings.
 - 2. Review design for ability of systems to be controlled including the following:
 - a. Confirm proper hardware requirements exist to perform functional performance testing.
 - b. Confirm proper safeties and interlocks are included in design.

- c. Confirm proper sizing of system control valves and actuators and control valve operation will result in capacity control identified in Contract Documents.
 - d. Confirm proper sizing of system control dampers and actuators, and damper operation will result in proper damper positioning.
 - e. Confirm sensors selected are within device ranges.
 - f. Review sequences of operation and obtain clarification from Engineer.
 - g. Indicate delineation of control between packaged controls and building automation system, listing BAS monitor points and BAS adjustable control points.
 - h. Provide written sequences of operation for packaged controlled equipment. Equipment manufacturers' stock sequences may be included, when accompanied by additional narrative to reflect Project conditions.
- 3. Inspect, check, and confirm proper operation and performance of control hardware and software provided in other HVAC sections.
- 4. Submit proposed procedures for performing automatic temperature control system point-to-point checks to Commissioning Authority and Engineer.
- 5. Inspect, check, and confirm correct installation and operation of automatic temperature control system input and output device operation through point-to-point checks.
- 6. Perform training sessions to instruct Owner's personnel in hardware operation, software operation, programming, and application in accordance with commissioning plan and requirements of Section, INSTRUMENTATION AND CONTROL FOR HVAC.
- 7. Demonstrate system performance and operation to Commissioning Authority during functional performance tests including each mode of operation.
- 8. Provide control system technician to assist during Commissioning Authority verification check and functional performance testing.
- 9. Provide control system technician to assist testing, adjusting, and balancing agency during performance of testing, adjusting, and balancing work.
- 10. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.
- C. Testing, Adjusting, and Balancing Agency Commissioning Responsibilities:
 - 1. Attend commissioning meetings.
 - 2. Participate in verification of testing, adjusting, and balancing report for verification or diagnostic purposes.
 - 3. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

1.5 COMMISSIONING MEETINGS

- A. Attend initial commissioning meeting and progress commissioning meetings as required by Commissioning Authority.

1.6 COORDINATION

- A. Notify Commissioning Authority minimum of 4 weeks in advance of the following:
 - 1. Scheduled equipment and system startups.
 - 2. Scheduled automatic temperature control system checkout.
 - 3. Scheduled start of testing, adjusting, and balancing work.

- B. Coordinate programming of automatic temperature control system with construction and commissioning schedules.

PART 2 PRODUCTS

2.1 Not Used.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install additional balancing dampers, balancing valves, access doors, test ports, and pressure and temperature taps required by Commissioning Authority.
- B. Place HVAC systems and equipment into full operation and continue operation during each working day of commissioning.
- C. Install replacement sheaves and belts to obtain system performance, as requested by Commissioning Authority.
- D. Install test holes in ductwork and plenums as requested by Commissioning Authority for taking air measurements.

END OF SECTION

SECTION 230923
INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 GENERAL

1.1 WORK DESCRIPTION

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. Scope: This section contains general requirements for all work to be provided by the Temperature Controls Contractor.
- C. The temperature controls contractor shall be responsible for providing and verifying all control sequences described in this section or in the Sequence of Operations regardless of whether the sequence uses the building automation system, unitary controls or third-party control systems, or any combination of systems. Any deviation from the sequence of operations, including limitations caused by the lack of ability of the building automation system to interact with unitary or third-party controls shall be clearly and prominently described as a deviation in the temperature controls submittal. The temperature controls contractor shall be responsible for coordinating and assuring the sequence of operations will be compatible with all equipment, including equipment purchased by other contractors. The temperature controls contractor will be responsible for correcting any interface problems that prevent the system from operating according to the sequence of operations.
- D. Work Included: It is the intent of this specification for the building automation system to be fully networked and installed as a complete package by the Temperature Controls Contractor. The system shall include all computer software and hardware, controllers, sensors, transmission equipment, system workstations, local panels, installation, engineering, supervision, commissioning, acceptance test, training, warranty service and, at the owner's option, extended warranty service.
- E. All controller hardware and software provided under this section shall be BACnet MS/TP to provide the owner with an open, interoperable direct digital control system that will allow microprocessor control hardware and software from different control, fire alarm or card access system manufacturers to be integrated to this control system.
- F. Portions of the building have existing HVAC equipment to remain. This equipment is served by Johnson Controls pneumatic and DDC systems. The new control system shall include communication with the existing controls.
 - 1. The exact routing of the existing control wiring and pneumatic tubing is unknown. The contractor shall field verify and make modifications as necessary to keep all existing equipment and controls that are to remain connected to the control system.
- G. Line Voltage: It is the intent of this specification for the temperature controls contractor to provide all wiring and conduit for the purpose of temperature controls, whether low voltage or line voltage (120vac or less). The temperature controls contractor shall coordinate with the Electrical Contractor to have the Electrical Contractor locate a junction box or boxes served by 120volt for the purpose of temperature controls. For devices that require line voltage (120vac or less) controls, the thermostat and wiring and conduit shall be the responsibility of the temperature controls contractor. If additional circuits/breakers are required it shall be the responsibility of the electrical contractor to provide. The temperature controls contractor shall not exclude line voltage controls in their proposal.

- H. Commissioning:
 - 1. The project will have selected building systems commissioned. The equipment and systems to be commissioned are specified in Section 230800. The commissioning process and contractor responsibilities are described in Section 230800. The controls contractor shall cooperate with the commissioning authority for collection of trend data for short term monitoring. This may involve using the building automation system for a three-week period of trend data collection of points specified by the commissioning authority and/or providing temporary remote monitoring capabilities of the BAS to the commissioning authority (with a temporary software license if needed).

1.2 PRODUCTS NOT FURNISHED OR INSTALLED UNDER BUT INTEGRATED WITH THE WORK OF THIS SECTION

- A. Section 23 21 23 – Hydronic Pumps
 - 1. Heating hot water pumps shall be furnished with integrated variable frequency drives.
- B. Section 23 36 00 – Air Terminal Units
 - 1. VAV boxes: VAV Terminal Units shall be furnished configured to accept control inputs from an external building automation system controller as specified in Section 23 09 93. Factory mounted safeties and other controls shall not interfere with this controller.

1.3 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.
- B. The following sections constitute related work:
 - 1. 23 05 14 – Variable Frequency Drives
 - 2. 23 08 00 – Commissioning of HVAC
 - 3. 23 09 93 – Sequence of Operation for HVAC Controls
 - 4. 23 21 23 – Hydronic Pumps
 - 5. 23 34 00 – HVAC Fans
 - 6. 23 36 00 – Air Terminal Units
 - 7. 23 57 00 – Heat Exchangers for HVAC
 - 8. 23 73 00 – Indoor Central Station Air Handlers
 - 9. Division 26 – Electrical
 - 10. Division 27 – Communications
 - 11. Division 28 – Electronic Safety and Security
- C. Refer to Division 26 sections for Electrical Provisions. Sources of 120-volt electrical power as indicated on the electrical drawings and specifications for control system components furnished by this section. The controls contractor shall be responsible for all additional electrical distribution from these connection points to the control panels and other controls devices.
- D. BAS contractor will furnish, but not install the following:
 - 1. Air flow measuring stations: furnish to mechanical installer and coordinate per manufacturer's requirements.
 - 2. Flow meters: furnish to mechanical installer and coordinate per manufacturer's requirements.
 - 3. Flow switches: furnish to mechanical installer and coordinate per manufacturer's requirements.

4. Hydronic pressure and temperature sensor wells: furnish to mechanical installer and coordinate per manufacturer's requirements.
 5. Control valves: furnish to mechanical installer and coordinate per manufacturer's requirements.
- E. Coordination Meeting: The Installer furnishing the DDC network shall meet with the Installer(s) furnishing each of the following products to coordinate details of the interface between these products and the DDC network. The Owner or his designated representative shall be present at this meeting. Each Installer shall provide the Owner and all other Installers with details of the proposed interface including PICS for BACnet equipment, hardware and software identifiers for the interface points, network identifiers, wiring requirements, communication speeds, and required network accessories. The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the DDC network. Submittals for these products shall not be approved prior to the completion of this meeting.

1.4 DESCRIPTION

- A. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface.
- B. System software shall be based on a server/thin client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's local area network, and (at the owner's discretion) over the Internet. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.
- C. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, setpoints, trends and alarms specified in 23 09 93 – "Sequence of Operations for HVAC Controls" shall be BACnet objects.

1.5 APPROVED CONTROL SYSTEM MANUFACTURERS

- A. The following are approved control system suppliers, manufacturers, and product lines:

Supplier	Manufacturer
Johnson Controls	Johnson Controls Inc.
Delta Connects	Delta Controls
SunBelt Controls	Reliable Controls Corporation

1. The above list does not indicate order of preference. Inclusion on this list does not guarantee acceptance of products or installation. Control systems shall comply with the terms of this specification.
2. The Contractor shall use only operator workstation software, controller software, custom application programming language, and controllers from the corresponding manufacturer and product line unless Owner approves use of multiple manufacturers.
3. Other products specified herein (such as sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.

1.6 QUALITY ASSURANCE

- A. Installer and Manufacturer Qualifications
 - 1. Installer shall have an established working relationship with Control System Manufacturer.
 - 2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.

1.7 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to the receipt of bids of the following codes:
 - 1. National Electric Code (NEC)
 - 2. ANSI/ASHRAE Standard 135, BACnet - A Data Communication Protocol for Building Automation and Control Systems

1.8 SYSTEM PERFORMANCE

- A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
 - 1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
 - 2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
 - 3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
 - 4. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
 - 5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 45 sec.
 - 6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.
 - 7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
 - 8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 sec of other workstations.
 - 9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.
 - 10. Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

Table-1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C (±1°F)
Ducted Air	±0.5°C (±1°F)
Outside Air	±1.0°C (±2°F)
Dew Point	±1.5°C (±3°F)
Water Temperature	±0.5°C (±1°F)
Delta-T	±0.15° (±0.25°F)
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (see Note 2)
Electrical	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO2)	±50 ppm

Note 1: Accuracy applies to 10%–100% of scale
Note 2: For both absolute and differential pressure
Note 3: Not including utility-supplied meters

Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0–1.5 kPa (0–6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0°C (±2.0°F)	
Duct Temperature	±1.5°C (±3°F)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1–150 psi) 0–12.5 kPa (0–50 in. w.g.) differential

1.9 SUBMITTALS

- A. Product Data and Shop Drawings: Meet requirements of Section 01 30 00 on Shop Drawings, Product Data, and Samples. In addition, the contractor shall provide shop drawings or other submittals on hardware, software, and equipment to be installed or provided. No work may begin on any segment of this project until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and three 11" x 17" prints of each drawing. When manufacturer's cutsheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawing shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Submittals shall be provided within 12 weeks of contract award. Submittals shall include:
1. DDC System Hardware
 - a. A complete bill of materials to be used indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
 - b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
 - 1) Direct digital controllers (controller panels)
 - 2) Transducers and transmitters
 - 3) Sensors (including accuracy data)
 - 4) Actuators
 - 5) Valves
 - 6) Flow meters
 - 7) Relays and switches
 - 8) Control panels
 - 9) Power supplies
 - 10) Batteries
 - 11) Operator interface equipment
 - 12) Wiring
 - a. Wiring diagrams and layouts for each control panel. Show termination numbers.
 - b. Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware. Riser diagrams showing control network layout, communication protocol, and wire types.
 2. Central System Hardware and Software
 - c. A complete bill of material of equipment used indicating quantity, manufacturer, model number, and relevant technical.
 - d. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:
 - 1) Central Processing Unit (CPU) or web server
 - 2) Monitors
 - 3) Keyboards
 - 4) Power supplies

- 5) Battery backups
 - 6) Interface equipment between CPU or server and control panels
 - 7) Operating System software
 - 8) Operator interface software
 - 9) Color graphic software
 - 10) Third-party software
 - e. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show interface wiring to control system.
 - f. Network riser diagrams of wiring between central control unit and control panels.
3. Controlled Systems
- a. Riser diagrams showing control network layout, communication protocol, and wire types.
 - b. A schematic diagram of each controlled system. The schematics shall have all control points labeled with point names shown or listed. The schematics shall graphically show the location of all control elements in the system.
 - c. A schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
 - d. An instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
 - e. A mounting, wiring, and routing plan-view drawing. The design shall take into account HVAC, electrical, and other systems' design and elevation requirements. The drawing shall show the specific location of all concrete pads and bases and any special wall bracing for panels to accommodate this work.
 - f. A complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system. Cutting and pasting the sequence of operation from Section 23 09 93 is not acceptable.
 - g. A point list for each control system. List I/O points and software points specified in Section 23 09 93. Indicate alarmed and trended points.
4. Sample graphics in pdf format for all system types.
5. Quantities of items submitted shall be reviewed but are the responsibility of the Contractor.
6. A description of the proposed process along with all report formats and checklists to be used in Section 23 09 23 Article 3.17 (Control System Demonstration and Acceptance).
7. BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface.
- B. Schedules
1. Within one month of contract award, provide a schedule of the work indicating the following:
 - a. Intended sequence of work items
 - b. Start date of each work item
 - c. Duration of each work item

- d. Planned delivery dates for ordered material and equipment and expected lead times
 - e. Milestones indicating possible restraints on work by other trades or situations
 - 2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.
- C. Project Record Documents. Upon completion of installation, submit three copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and shall include:
 - 1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD compatible files on magnetic or optical media (file format: .DWG, .DXF, .VSD, or comparable) and as 11" x 17" prints.
 - 2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Section 23 09 23 Article 3.17 (Control System Demonstration and Acceptance).
 - 3. Operation and Maintenance (O&M) Manual.
 - 4. As-built versions of submittal product data.
 - 5. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
 - 6. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 - 7. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 - 8. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
 - 9. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
 - 10. Graphic files, programs, and database on magnetic or optical media.
 - 11. List of recommended spare parts with part numbers and suppliers.
 - 12. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
 - 13. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
 - 14. Licenses, guarantees, and warranty documents for equipment and systems.
 - 15. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
- D. Training Materials: Provide course outline and materials for each class at least six weeks before first class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training. Engineer will modify course outlines and materials if necessary to meet

Owner's needs. Engineer will review and approve course outlines and materials at least three weeks before first class.

1.10 WARRANTY

A. Warrant work as follows:

1. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
3. If the engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, the engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.
4. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve the contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
5. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.11 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
1. Graphics
 2. Record drawings
 3. Database
 4. Application programming code
 5. Documentation

1.12 DEFINITIONS

Term	Definition
BACnet Interoperability Building Blocks (BIBB)	A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBS are combined to build the BACnet functional requirements for a device in a specification.
BACnet/BACnet Standard	BACnet communication requirements as defined by the latest version of ASHRAE/ANSI 135 and approved addenda.
Control Systems Server	A computer(s) that maintain(s) the systems configuration and programming database.

Term	Definition
Controller	Intelligent stand-alone control device. Controller is a generic reference to building controllers, custom application controllers, and application specific controllers.
Direct Digital Control	Microprocessor-based control including Analog/Digital conversion and program logic.
Gateway	Bi-directional protocol translator connecting control systems that use different communication protocols.
Local Area Network	Computer or control system communications network limited to local building or campus.
Master-Slave/Token Passing	Data link protocol as defined by the BACnet standard.
Point-to-Point	Serial communication as defined in the BACnet standard.
Primary Controlling LAN	High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs. Refer to System Architecture below.
Protocol Implementation Conformance Statement	A written document that identifies the particular options specified by BACnet that are implemented in a device.
Router	A device that connects two or more networks at the network layer.
Wiring	Raceway, fittings, wire, boxes and related items.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.
- B. Install new wiring and network devices as required to provide a complete and workable control network.
- C. Use existing Ethernet backbone for network segments marked "existing" on project drawings.
- D. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- E. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
 - 1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
 - 2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in

Section 23 09 93. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.

- F. Workstations, Building Control Panels, and Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight saving and standard time as applicable.
- G. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

2.3 OPERATOR INTERFACE

- A. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information. The Operator Workstation or server shall conform to the BACnet Operator Workstation (B-OWS) or BACnet Advanced Workstation (B-AWS) device profile as specified in ASHRAE/ANSI 135 BACnet Annex L.
- B. Communication. Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ANSI/ASHRAE 135, BACnet Annex J.
- C. Hardware.
 - 1. Workstation or web server. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified elsewhere in this document. The following hardware requirements also apply:
 - a. The hard disk shall have sufficient memory to store:
 - 1) All required operator workstation software.
 - 2) A DDC database at least twice the size of the delivered system database.
 - 3) One year of trend data based on the points specified to be trended at their specified trend intervals.
 - b. Provide additional hardware (communication ports, video drivers, network interface cards, cabling, etc.) to facilitate all control functions and software requirements specified for the DDC system.
 - c. Minimum hardware configuration shall include the following:
 - 1) Quad Core Processor
 - 2) 8 GB RAM
 - 3) 1 TB hard disk providing data at 3.0 Gb/sec
 - 4) 16x DVD+/-RW drive
 - 5) Serial, parallel, and network communication ports and cables as required for proper DDC system operation
- D. System Software.
 - 1. Operating System. Web server or workstation shall have an industry-standard professional-grade operating system. Operating system shall meet or exceed the DDC System manufacturers minimum requirements for their software. Acceptable systems include Microsoft Windows 7 or 8, Microsoft Vista, Windows Server 2008 or 2012, Red Hat Enterprise Linux, or Ubuntu Desktop 12.04.
 - 2. System Graphics. The operator interface software shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each

floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.

- a. **Functionality.** Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
 - b. **Animation.** Graphics shall be able to animate by displaying different image files for changed object status.
 - c. **Alarm Indication.** Indicate areas or equipment in an alarm condition using color or other visual indicator.
 - d. **Format.** Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in or shall only require widely available no-cost plug-ins (such as Adobe Flash).
3. **Custom Graphics.** Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in the same formats as are used for system graphics.
4. **Graphics Library.** Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.
- E. **System Applications.** System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.
 1. **Automatic System Database Configuration.** Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
 2. **Manual Controller Memory Download.** Operators shall be able to download memory from the system database to each controller.
 3. **System Configuration.** The workstation software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password protection. Operators shall be able to configure the system.
 4. **On-Line Help.** Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
 5. **Security.** Each operator shall be required to log on to the system with user name and password in order to view, edit, add, or delete data.
 - a. **Operator Access.** The user name and password combination shall define accessible viewing, editing, adding, and deleting privileges for that operator.

- Users with system administrator rights shall be able to create new users and edit the privileges of all existing users.
- b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. This auto logoff time shall be user adjustable.
 - c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
6. System Diagnostics. The system shall automatically monitor the operation of all building management panels and controllers. The failure of any device shall be annunciated to the operator.
 7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 23 09 93 (Sequences of Operation). Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
 8. Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying on acronyms or mnemonics.
 9. Alarm Reactions. Operator shall be able to configure (by object) what, if any actions are to be taken during an alarm. As a minimum, the workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
 10. Alarm and Event log. Operators shall be able to view all system alarms and changes of state from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and delete alarms, and archive closed alarms to the workstation or web server hard disk.
 11. Trend Logs. The operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in Section 23 09 93 (Sequences of Operation). Trends shall be BACnet trend objects.
 12. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object or property in the system. The status shall be available by menu, on graphics, or through custom programs.
 13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
 14. Standard Reports. Furnish the following standard system reports:
 - a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
 - b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
 - c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
 - 1) Alarm History.

- 2) Trend Data. Operator shall be able to select trends to be logged.
 - 3) Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
15. Energy Reports. System shall include an easily configured energy reporting tool that provides the capabilities described in this section.
- a. The energy reporting tool shall be accessible through the same user interface (Web browser or operator workstation software) as is used to manage the BAS.
 - b. The energy reporting tool shall be preconfigured by the Contractor to gather and store energy demand and consumption data from each energy source that provides metered data to the BAS. Meter data shall be stored at 5 minute intervals unless otherwise specified in the Sequence of Operation provided in section 23 09 93. This data shall be maintained in an industry standard SQL database for a period of not less than five years.
 - c. The energy reporting tool shall allow the operator to select an energy source and a time period of interest (day, week, month, year, or date range) and shall provide options to view the data in a table, line graph, bar graph, or pie chart. The tool shall also allow the operator to select two or more data sources and display a comparison of the energy used over this period in any of the listed graph formats, or to total the energy used by the selected sources and display that data in the supported formats.
 - d. The energy reporting tool shall allow the operator to select an energy source and two time periods of interest (day, week, month, year, or date range) and display a graph that compares the energy use over the two time periods in any of the graph formats listed in the previous paragraph. The tool shall also allow the operator to select multiple energy sources and display a graph that compares the total energy used by these sources over the two time periods.
 - e. The energy reporting tool shall allow the operator to easily generate the previously described graphs "on the fly," and shall provide an option to store the report format so the operator can select that format to regenerate the graph at a future date. The tool shall also allow the user to schedule these reports to run on a recurring basis using relative time periods, such as automatically generating a consumption report on the first Monday of each month showing consumption over the previous month. Automatically generated reports shall be archived on the server in a common industry format such as Adobe PDF or Microsoft Excel with copies e-mailed to a user editable list of recipients.
 - f. The energy reporting tool shall be capable of collecting and displaying data from the following types of meters:
 - 1) Electricity
 - 2) Steam
 - 3) Chilled Water
 - 4) Potable Water
 - 5) Heating and cooling degree days. (May be calculated from sensor data rather than metered.)

- g. The user shall have the option of using Kw (Kwh) or Btu/hr (Btu) as the units for demand and consumption reports. Multiples of these units (MWH, kBtu, etc.) shall be used as appropriate. All selected sources shall be automatically converted to the selected units. The user shall similarly have the option of entering facility area and occupancy hours and creating reports that are normalized on an area basis, an annual use basis, or an occupied hour basis.
- h. The user shall have the option of entering benchmark data for an individual facility or a group of facilities.
- i. The user shall have the option of displaying any or all of the following data on any chart, line, or bar graph generated by the energy reporting tool:
 - 1) Low/High/Average value of the metered value being displayed.
 - 2) Heating and/or Cooling Degree Days for the time period(s) being displayed.
- 16. Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.
- 17. Interlock the emergency shut down and cold weather procedures from all other buildings on campus. User shall be able to access an emergency window to shut down any individual piece of equipment or the entire building with a single click in the event of a terrorist incident or any other user-specified event.
- F. Workstation Application Editors. Each PC or browser workstation shall support editing of all system applications. The applications shall be downloaded and executed at one or more of the controller panels.
 - 1. Controller. Provide a full-screen editor for each type of application that shall allow the operator to view and change the configuration, name, control parameters, and set points for all controllers.
 - 2. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a method of selecting the desired schedule and schedule type. Exception schedules and holidays shall be shown clearly on the calendar. The start and stop times for each object shall be adjustable from this interface.
 - 3. Custom Application Programming. Provide the tools to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:
 - a. Language. Language shall be graphically based and shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks.
 - b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.
 - c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.

- d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
- e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
- f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.
- g. Variables. Operator shall be able to use variable values in program conditional statements and mathematical functions.
 - 1) Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.
 - 2) System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.
- G. Portable Operator's Terminal. Provide all necessary software to configure an IBM-compatible laptop computer for use as a Portable Operator's Terminal. Operator shall be able to connect configured Terminal to the system network or directly to each controller for programming, setting up, and troubleshooting.

2.4 Controller Software

- A. Furnish the following applications for building and energy management. All software application shall reside and operate in the system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
- B. System Security. See Paragraph 2.3.E.5 (Security) and Paragraph 2.3.E.14.c.iii (Operator Activity).
- C. Scheduling. Provide the capability to execute control functions according to a user created or edited schedule. Each schedule shall provide the following schedule options as a minimum:
 - 1. Weekly Schedule. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
 - 2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule has executed, the system shall discard and replace the exception schedule with the standard schedule for that day of the week.
 - 3. Holiday Schedules. Provide the capability for the operator to define up to 24 special or holiday schedules. These schedules will be repeated each year. The operator shall be able to define the length of each holiday period.

- D. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
- E. Binary Alarms. Each binary object shall have the capability to be configured to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.
- F. Analog Alarms. Each analog object shall have both high and low alarm limits. The operator shall be able to enable or disable these alarms.
- G. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display on graphics.
- H. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.
- I. Demand Limiting.
 - 1. The demand-limiting program shall monitor building power consumption from a building power meter (provided by others) which generates pulse signals or a BACnet communications interface. An acceptable alternative is for the system to monitor a watt transducer or current transformer attached to the building feeder lines.
 - 2. When power consumption exceeds adjustable levels, system shall automatically adjust setpoints, de-energize low-priority equipment, and take other programmatic actions to reduce demand as specified in Section 23 09 93 (Sequences of Operation). When demand drops below adjustable levels, system shall restore loads as specified.
- J. Maintenance Management. The system shall be capable of generating maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in 23 09 93 (Sequences of Operation).
- K. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in Section 23 09 93 (Sequences of Operation).
- L. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs. The calculation interval, PID gains, and other tuning parameters shall be adjustable by a user with the correct security level.
- M. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
- N. Energy Calculations.
 - 1. The system shall accumulate and convert instantaneous power (kW) or flow rates (L/s [gpm]) to energy usage data.
 - 2. The system shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.
- O. Anti-Short Cycling. All binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
- P. On and Off Control with Differential. Provide an algorithm that allows a binary output to be cycled based on a controlled variable and a setpoint. The algorithm shall be direct-acting or reverse-acting.
- Q. Runtime Totalization. Provide software to totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit.

Configure and enable runtime totalization and alarms as specified in Section 23 09 93 (Sequence of Operations).

2.5 CONTROLLERS

- A. General. Provide an adequate number of Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified in Section 23 09 23 Article 1.8 (System Performance). Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors.
- B. BACnet.
 - 1. Building Controllers (BCs). Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L, and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.
 - 2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
 - 3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
 - 4. Smart Sensors (SSs). Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.
 - 5. BACnet Communication.
 - a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.
 - b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
 - c. Each AAC shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - d. Each ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - e. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - f. Each SS shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using ARCNET or MS/TP Data Link/Physical layer protocol.
 - 6. Communication
 - g. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.

- h. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
 - i. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
 - j. Stand-Alone Operation. Each piece of equipment specified in Section 23 09 93 shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network such as outdoor air conditions, supply air or water temperature coming from source equipment, etc.
- 7. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
 - a. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
 - b. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).
- 8. Keypad. Provide a local keypad and display for each BC and AAC. Operator shall be able to use keypad to view and edit data. Keypad and display shall require password to prevent unauthorized use. If the manufacturer does not normally provide a keypad and display for each BC and AAC, provide the software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the system.
- 9. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.
- 10. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to a field-removable modular terminal strip or to a termination card connected by a ribbon cable. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.
- 11. Memory.
 - a. Controller memory shall support operating system, database, and programming requirements.
 - b. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
 - c. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
- 12. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
- 13. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.6 INPUT AND OUTPUT INTERFACE

- A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.

- B. Protection. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground shall cause no damage to the controller. All input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no controller damage.
- C. Binary Inputs. Binary inputs shall allow the monitoring of ON/OFF signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.
- D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall also accumulate up to 10 pulses per second.
- E. Analog Inputs. Analog inputs shall allow the monitoring of low-voltage (0–10 Vdc), current (4–20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- F. Binary Outputs. Binary outputs shall provide for ON/OFF operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on Building Controllers shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
- G. Analog Outputs. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0–10 Vdc or a 4–20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- I. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.
- J. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system

2.7 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
 - 1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.

- a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
- b. Line voltage units shall be UL recognized and CSA listed.
- 2. Power Line Filtering.
 - a. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
 - 1) Dielectric strength of 1000 V minimum
 - 2) Response time of 10 nanoseconds or less
 - 3) Transverse mode noise attenuation of 65 dB or greater
 - 4) Common mode noise attenuation of 150 dB or greater at 40–100 Hz

2.8 AUXILIARY CONTROL DEVICES

- A. Motorized Control Dampers, unless otherwise specified elsewhere, shall be as follow.
 - 1. Type. Control dampers shall be the parallel or opposed-blade type as specified below or as scheduled on drawings.
 - a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
 - b. Other modulating dampers shall be opposed-blade.
 - c. Two-position shutoff dampers shall be parallel- or opposed-blade with blade and side seals.
 - 2. Frame. Damper frames shall be 2.38 mm (13 gauge) galvanized steel channel or 3.175 mm (1/8 in.) extruded aluminum with reinforced corner bracing.
 - 3. Blades. Damper blades shall not exceed 20 cm (8 in.) in width or 125 cm (48 in.) in length. Blades shall be suitable for medium velocity (10 m/s [2000 fpm]) performance. Blades shall be not less than 1.5875 mm (16 gauge).
 - 4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
 - 5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than 50 L/s·m² (10 cfm per ft²) at 1000 Pa (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of 7.5 m/s (1500 fpm).
 - 6. Sections. Individual damper sections shall not exceed 125 cm × 150 cm (48 in. × 60 in.). Each section shall have at least one damper actuator.
 - 7. Modulating dampers shall provide a linear flow characteristic where possible.
 - 8. Linkages. Dampers shall have exposed linkages.
- B. Electric Damper and Valve Actuators.
 - 1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
 - 2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
 - 3. Signal and Range. Proportional actuators shall accept a 0–10 Vdc or a 0–20 mA control signal and shall have a 2–10 Vdc or 4–20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications as described in paragraph 2.6H.)
 - 4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.

5. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.
- C. Control Valves.
1. Control valves shall be two-way or three-way type for two-position or modulating service as shown.
 2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
 - a. Water Valves:
 - 1) Two-way: 150% of total system (pump) head.
 - 2) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 - b. Steam Valves: 150% of operating (inlet) pressure.
 3. Water Valves.
 - a. Body and trim style and materials shall be in accordance with manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
 - b. Sizing Criteria:
 - 1) Two-position service: Line size.
 - 2) Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 5 psi, whichever is greater.
 - 3) Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa (5 psi) maximum.
 - 4) Valves ½ in. through 2 in. shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two-position service. Two-way valves to have replaceable composition disc or stainless steel ball.
 - 5) Valves 2½ in. and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.
 - c. Water valves shall fail normally open or closed, as scheduled on plans, or as follows:
 - 1) Water zone valves—normally open preferred.
 - 2) Heating coils in air handlers—normally open.
 - 3) Chilled water control valves—normally closed.
 - 4) Other applications—as scheduled or as required by sequences of operation.
 4. Steam Valves.
 - a. Body and trim materials shall be in accordance with manufacturer's recommendations for design conditions and service with linear ports for modulating service.
 - b. Sizing Criteria:
 - 1) Two-position service: pressure drop 10% to 20% of inlet psig.

- 2) Modulating service: 100 kPa (15 psig) or less; pressure drop 80% of inlet psig.
 - 3) Modulating service: 101 to 350 kPa (16 to 50 psig); pressure drop 50% of inlet psig.
 - 4) Modulating service: over 350 kPa (50 psig); pressure drop as scheduled on plans.
- D. Binary Temperature Devices.
1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C–30°C (55°F–85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
 2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C–30°C (55°F–85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
 3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.
- E. Temperature Sensors.
1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
 2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m²(10 ft²) of duct cross-section.
 3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
 4. Space Sensors. Space sensors shall have setpoint adjustment, override switch, display, and communication port.
 5. Differential Sensors. Provide matched sensors for differential temperature measurement.
- F. Humidity Sensors.
1. Duct and room sensors shall have a sensing range of 20%–80%.
 2. Duct sensors shall have a sampling chamber.
 3. Outdoor air humidity sensors shall have a sensing range of 20%–95% RH and shall be suitable for ambient conditions of -40°C–75°C (-40°F–170°F).
 4. Humidity sensors shall not drift more than 1% of full scale annually.
- G. Flow Switches. Flow-proving switches shall be paddle (water service only) or differential pressure type (air or water service) as shown. Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).
1. Paddle switches shall have adjustable sensitivity and NEMA 1 enclosure unless otherwise specified.
 2. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.
- H. Relays.

1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
 2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable $\pm 100\%$ from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.
- I. Override Timers.
1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0–6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.
- J. Current Transmitters.
1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4–20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
 2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
 3. Unit shall be split-core type for clamp-on installation on existing wiring.
- K. Current Transformers.
1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
 2. Transformers shall be available in various current ratios and shall be selected for $\pm 1\%$ accuracy at 5 A full-scale output.
 3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.
- L. Voltage Transmitters.
1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4–20 mA output with zero and span adjustment.
 2. Adjustable full-scale unit ranges shall be 100–130 Vac, 200–250 Vac, 250–330 Vac, and 400–600 Vac. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
 3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.
- M. Voltage Transformers.
1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
 2. Transformers shall be suitable for ambient temperatures of 4°C–55°C (40°F–130°F) and shall provide $\pm 0.5\%$ accuracy at 24 Vac and 5 VA load.
 3. Windings (except for terminals) shall be completely enclosed with metal or plastic.
- N. Power Monitors.
1. Selectable rate pulse output for kWh reading, 4–20 mA output for kW reading, N.O. alarm contact, and ability to operate with 5.0 amp current inputs or 0–0.33 volt inputs.
 2. 1.0% full-scale true RMS power accuracy, ± 0.5 Hz, voltage input range 120–600 V, and auto range select.
 3. Under voltage/phase monitor circuitry.

4. NEMA 1 enclosure.
 5. Current transformers having a 0.5% FS accuracy, 600 VAC isolation voltage with 0–0.33 V output. If 0–5 A current transformers are provided, a three-phase disconnect/shorting switch assembly is required.
- O. Hydronic Flowmeters
1. Ultrasonic Flowmeters for chilled water and pumped condensate
 - a. Basis of Design: ONICON Model F-4600 Series Inline Ultrasonic Flowmeter.
 - b. Description: Provide an inline flowmeter complete with direct beam wetted ultrasonic transducers, temperature sensor, mounting hardware and calibration certificate.
 - c. Application Range: This contractor shall be responsible for selecting the flowmeter options submitted based on the application. Flowmeter shall be selected for the intended application in terms of pipe size, pipe material, installation requirements, expected flow rate, ambient conditions and fluid characteristics which include but are not limited to pressure, temperature, and viscosity.
 - d. Design - Sensing Technology: Ultrasonic flow sensing element shall utilize matched direct path, wetted ultrasonic transducers and 1000 OHM Platinum RTD.
 - e. Construction: Flowmeter shall consist of a drop forged corrosion resistant metal flow body with process connections, integral transducers and a processor / transmitter. All wetted materials shall be NSF 372 compliant.
 - f. Maximum Pressure Rating: 400psi
 - g. Maximum Temperature Rating: 250F
 - h. Mounting Connections: For NPS ½" – 2", piping connections shall be male NPT threads; for NPS 2 ½" provide ANSI class flange, rated for maximum system temperature and pressure.
 - i. Flow Range: Flow-measuring element and transmitter shall cover operating range of equipment or system served.
 - j. Accuracy: Flowmeter shall provide calibrated outputs directly from the transmitter, throughout the operating range with the accuracy stated as follows:
 - 1) Plus or minus 1.0% of flow rate over a 25:1 turndown
 - 2) Plus or minus 2.0% of flow rate over a 100:1 turndown
 - 3) Overall turndown of 500:1
 - k. Transmitter: Transmitter shall provide instantaneous flow rate information over a 4-20mA scale and a pulse output for totalized flow information.
- P. Steam Flowmeters
1. Vortex Shedding Flowmeter
 - a. Basis of Design: ONICON Model F-2600 Series.
 - b. Description: Furnish and install a Vortex Mass Flow Meter complete with integral density compensation to provide direct mass steam flow output. Temperature sensor, mounting hardware and calibration certificate.
 - c. Application Range: This contractor shall be responsible for selecting the flowmeter options submitted based on the application. Flowmeter shall be selected for the intended application in terms of pipe size, pipe material, installation requirements, expected flow rate, ambient conditions and fluid

characteristics which include but are not limited to pressure, temperature, and viscosity.

- d. Design: The flow meter shall calculate mass flow corrected for density with real time calculations based on temperature measured by an integral 1,000 ohm platinum RTD.
- e. Construction: The meter shall be provided with ANSI class 150 or class 300 flanges as required to meet system requirements. The maximum operating temperature shall be 500° F. The flow meter body shall be constructed of 316L stainless steel and include a weather-tight NEMA-4X aluminum electronics enclosure.
- f. Transmitter: The meter shall provide a loop-powered 4-20 mA output signal calibrated in direct mass flow rate units for connection to the Central Control System. In addition, an integral pulse output for steam mass flow totalization shall be provided. All outputs shall be linear with mass flow rate.

Q. Airflow Measuring Arrays

- 1. Provide one thermal dispersion airflow/temperature measurement device (ATMD) at each location indicated on the plans, schedules and/or control schematics.
- 2. Each ATMD shall consist of one to four sensor probes and a single, remote transmitter. Each sensor probe shall consist of one to eight independent sensor nodes in a gold anodized, aluminum 6063 alloy tube with 304 stainless steel mounting brackets.
- 3. Each sensor node shall consist of two hermetically sealed bead-in-glass thermistors. Chip thermistors of any type or packaging are not acceptable.
- 4. The velocity-weighted average temperature output performance of the ATMD is preferred to that of the specified temperature measuring device (TMD), when the location of the ATMD and TMD are effectively the same.
- 5. Outside Air Measurement:
 - a. Provide a minimum outside airflow measuring station in a straight duct section upstream from the minimum outside air dampers and interfacing control for providing an electronic signal for use by the control contractor in controlling a minimum outside airflow. On outdoor mounted air handling units, outside airflow measurement station is to be factory mounted on the intake side of the outside air intake (upstream of the damper).
- 6. Sensor Performance:
 - a. Outside Air/duct Installation:
 - 1) Installed airflow accuracy: +/- 2% of reading with +/- 0.25% repeatability.
 - 2) Sensor probe performance: +/- 2% of reading, 0-5000 fpm, 0.15°F temperature accuracy +/-.
- 7. Transmitter:
 - a. Flow measuring array to include a transmitter for flow and temperature analog output signal for the building energy management system to be user selectable in either 4-20 mA or 0-10VDC. Coordinate signal output with controls installer.
 - b. Transmitter to include an analog airflow gauge to provide direct analog readout in cfm.
 - c. Mount on the outside of the air handler if air handler is located in a mechanical room. Mount in a NEMA 3R control cabinet if located outside.
 - d. Device to provide switch selectable Modbus or Johnson N2 outputs.

- e. Device to be UL listed.
- f. The transmitter shall be powered by 24 VAC, shall include over-voltage and over-current protection, and shall include watchdog circuitry to ensure continuous operation following power failures and/or brown-outs.
- g. The transmitter shall determine the airflow rate and temperature of each sensing node prior to averaging.
- h. The transmitter shall include self-diagnostics and other features to ensure reliability and continued operation despite a limited failure. The transmitter shall automatically detect sensor damage and correctly calculate the average using the remaining functional sensor nodes, while reporting a system fault over the network and by local visual indication.
- i. All integrated circuits shall be industrial rated for operation down to -40°F (-40°C).
- j. The environmental operating temperature limits for the transmitter shall be -20°F to 120°F (-28.8°C to 48.8°C).
- k. The system shall be factory tested prior to shipment and not require calibration or adjustment over the life of the equipment when installed in accordance to manufacturer's guidelines.
- l. The Sensors shall be calibrated to NIST traceable standards.
- 8. Airflow measuring station to be by Ebtron, KURZ, Fluid Components and Sierra Instruments or equal.
- R. Current Switches.
 - 1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.
- S. Pressure Transducers.
 - 1. Transducers shall have linear output signal and field-adjustable zero and span.
 - 2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
 - 3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4–20 mA output, suitable mounting provisions, and block and bleed valves.
 - 4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300psi.) Transducer shall have 4–20 mA output, suitable mounting provisions, and 5-valve manifold.
- T. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.
- U. Pressure-Electric (PE) Switches.
 - 1. Shall be metal or neoprene diaphragm actuated, operating pressure rated for 0–175 kPa (0–25 psig), with calibrated scale minimum setpoint range of 14–125 kPa (2–18 psig) minimum, UL listed.
 - 2. Provide one- or two-stage switch action (SPDT, DPST, or DPDT) as required by application. Electrically rated for pilot duty service (125 VA minimum) and/or for motor control.

3. Switches shall be open type (panel-mounted) or enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.
4. Each pneumatic signal line to PE switches shall have permanent indicating gauge.
- V. Occupancy Sensors. Occupancy sensors shall utilize Passive Infrared (PIR) and/or Microphonic Passive technology to detect the presence of people within a room. Sensors shall be mounted as indicated on the approved drawings. The sensor output shall be accessible by any lighting and/or HVAC controller in the system. Occupancy sensors shall be capable of being powered from the lighting or HVAC control panel, as shown on the drawings. Occupancy sensor delay shall be software adjustable through the user interface and shall not require manual adjustment at the sensor.
- W. Electro-Pneumatic (E/P) Transducers.
 1. E/P transducers shall proportionally convert a 4–20 mA or 0–10 Vdc analog control input to a 20–100 kPa (3–15 psig) output signal.
 2. E/P transducers shall have the following features:
 - a. Separate span and zero adjustments.
 - b. Manual output adjustments.
 - c. Pressure gauge assembly.
 - d. Feedback loop control.
 - e. Mid-range air consumption of 0.05 L/s (0.1 scfm).
- X. Local Control Panels.
 1. All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable subpanels. A single key shall be common to all field panels and subpanels.
 2. Interconnections between internal and face-mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/ interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
 3. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

2.9 WIRING AND RACEWAYS

- A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.
- B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

2.10 FIBER OPTIC CABLE SYSTEM

- A. Optical Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.
- B. Connectors. Field terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

PART 3 EXECUTION

3.1 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the architect/engineer for resolution before rough-in work is started.
- B. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started.
- C. The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the contractor's work and the plans and the work of others—the contractor shall report these discrepancies to the engineer and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the contractor to report such discrepancies shall be made by—and at the expense of—this contractor.

3.2 PROTECTION

- A. The contractor shall protect all work and material from damage by his/her work or employees and shall be liable for all damage thus caused.
- B. The contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The contractor shall protect any material that is not immediately installed. The contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION

- A. Site
 - 1. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition without extra charge.
 - 2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
- B. Submittals. See Section 23 09 23 Article 1.9 (Submittals).
- C. Test and Balance.
 - 1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
 - 2. The contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.
 - 3. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.
 - 4. The tools used during the test and balance process will be returned at the completion of the testing and balancing.
- D. Life Safety.
 - 1. Duct smoke detectors required for air handler shutdown are provided under Division 28. Interlock smoke detectors to air handlers for shutdown as specified in Section 23 09 93 (Sequences of Operation).

- E. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:
1. All communication media and equipment shall be provided as specified in Section 23 09 23 Article 2.2 (Communication).
 2. Each supplier of a controls product is responsible for the configuration, programming, start up, and testing of that product to meet the sequences of operation described in Section 23 09 93.
 3. The contractor shall coordinate and resolve any incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
 4. The contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.
 5. The contractor is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.

3.4 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring/raceway parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install equipment in readily accessible locations as defined by Chapter 1 Article 100 Part A of the National Electrical Code (NEC).
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All equipment, installation, and wiring shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.5 FIELD QUALITY CONTROL

- A. All work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 23 09 23 Article 1.7 (Codes and Standards).
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship.
- C. Contractor shall have work inspection by local and/or state authorities having jurisdiction over the work.

3.6 EXISTING EQUIPMENT

- A. Wiring. Interconnecting control wiring shall be removed and shall become the property of the contractor unless specifically noted or shown to be reused.
- B. Pneumatic Tubing. Interconnecting pneumatic control tubing shall be removed and shall become the property of the contractor unless specifically noted or shown to be reused.
- C. Local Control Panels. Remove and deliver existing control panels to Owner.
- D. Repair. Unless otherwise directed, the contractor is not responsible for repair or replacement of existing energy equipment and systems, valves, dampers, or actuators. Should the contractor find existing equipment that requires maintenance, the engineer is to be notified immediately.

- E. Indicator Gauges. Where these devices remain and are not removed, they must be made operational and recalibrated to ensure reasonable accuracy. Maintain the operation of existing pneumatic transmitters and gauges.
- F. Room Thermostats. Remove and deliver existing room thermostats to Owner unless otherwise noted. Patch and finish holes and marks left by removal to match existing walls.
- G. Electronic Sensors and Transmitters. Remove and deliver existing sensors and transmitters to Owner.
- H. Controllers and Auxiliary Electronic Devices. Remove and deliver existing controllers and auxiliary electronic devices to Owner.
- I. Pneumatic Controllers and Relays. Remove and deliver pneumatic controllers and relays to Owner.
- J. Damper Actuators, Linkages, and Appurtenances. Remove and deliver existing damper actuators, linkages and appurtenances to Owner.
- K. Control Valves. Replace existing control valves with new. Deliver removed control valves to Owner.
- L. Control Compressed Air Systems. Replace existing control compressed air systems with new unless otherwise noted. Deliver removed systems to Owner.
- M. Existing System Operating Schedule. Existing mechanical system may be disabled during this work.
- N. The scheduling of fans through existing or temporary time clocks or control system shall be maintained throughout the DDC system installation
- O. Install control panels where shown.
- P. Modify existing starter control circuits, if necessary, to provide hand-off-auto control of each controlled starter. If new starters or starter control packages are required, these shall be included as part of this contract.
- Q. Patch holes and finish to match existing walls.

3.7 WIRING

- A. All control and interlock wiring shall comply with national and local electrical codes, and Division 26 of this specification, Where the requirements of this section differ from Division 26, the requirements of this section shall take precedence.
- B. All NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and Division 26 requirements.
- C. All low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be subfused when required to meet Class 2 current limit.
- D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL listed for the intended application.
- E. All wiring in mechanical, electrical, or service rooms – or where subject to mechanical damage – shall be installed in raceway at levels below 3 m (10ft).
- F. Do not install Class 2 wiring in raceways containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).
- G. Do not install wiring in raceway containing tubing.
- H. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 3 m (10 ft) intervals.

- I. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
- J. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
- K. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- L. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers.
- M. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
- N. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
- O. Size of raceway and size and type of wire type shall be the responsibility of the contractor in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.
- P. Include one pull string in each raceway 2.5 cm (1 in.) or larger.
- Q. Use color-coded conductors throughout with conductors of different colors.
- R. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
- S. Conceal all raceways except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g. steam pipes or flues).
- T. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- U. Adhere to this specification's Division 26 requirements where raceway crosses building expansion joints.
- V. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of vertical raceways.
- W. The contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- X. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Flexible metal raceway less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.
- Y. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.8 COMMUNICATION WIRING

- A. The contractor shall adhere to the items listed in the "Wiring" article in Part 3 of the specification.
- B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling

- C. Do not install communication wiring in raceways and enclosures containing Class 1 or other Class 2 wiring.
- D. Maximum pulling, tension, and bend radius for the cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.
- E. Contractor shall verify the integrity of the entire network following cable installation. Use appropriate test measures for each particular cable.
- F. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to manufacturer's instructions.
- G. All runs of communication wiring shall be unspliced length when that length is commercially available.
- H. All communication wiring shall be labeled to indicate origination and destination data.
- I. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."
- J. BACnet MS/TP communications wiring shall be installed in accordance with ASHRAE/ANSI Standard 135. This includes but is not limited to:
 - 1. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot.)
 - 2. The maximum length of an MS/TP segment is 1200 meters (4000 ft) with AWG 18 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485.
 - 3. The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard. Additional nodes may be accommodated by the use of repeaters.
 - 4. An MS/TP EIA-485 network shall have no T connections.

3.9 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by wall framing.
- D. All wires attached to sensors shall be sealed in their raceways or in the wall to stop air transmitted from other areas from affecting sensor readings.
- E. Sensors used in mixing plenums and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.
- F. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m (1 ft) of sensing element for each 1 m²(1 ft²) of coil area.
- G. Do not install temperature sensors within the vapor plume of a humidifier. If installing a sensor downstream of a humidifier, install it at least 3 m (10 ft) downstream.
- H. All pipe-mounted temperature sensors shall be installed in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- I. Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.
- J. Differential Air Static Pressure.
 - 1. Supply Duct Static Pressure. Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding

- building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.
2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.
 3. Building Static Pressure. Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a thermostat cover.
 4. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
 5. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
 6. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shut-off valves installed before the tee.
- K. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

3.10 FLOW SWITCH INSTALLATION

- A. Use correct paddle for pipe diameter.
- B. Adjust flow switch according to manufacturer's instructions.

3.11 ACTUATORS

- A. General. Mount and link control damper actuators according to manufacturer's instructions.
 1. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
 2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 3. Provide all mounting hardware and linkages for actuator installation.
- B. Electric/Electronic
 1. Dampers: Actuators shall be direct mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° travel available for tightening the damper seal. Actuators shall be mounted following manufacturer's recommendations.
 2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.12 WARNING LABELS

- A. Permanent warning labels shall be affixed to all equipment that can be automatically started by the control system.
 1. Labels shall use white lettering (12-point type or larger) on a red background.
 2. Warning labels shall read as follows.

CAUTION

THIS EQUIPMENT IS OPERATING UNDER AUTOMATIC CONTROL AND MAY START OR STOP AT ANY TIME WITHOUT WARNING. SWITCH DISCONNECT TO "OFF" POSITION BEFORE SERVICING.

- B. Permanent warning labels shall be affixed to all motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.
 - 1. Labels shall use white lettering (12-point type or larger) on a red background.
 - 2. Warning labels shall read as follows.

CAUTION

THIS EQUIPMENT IS FED FROM MORE THAN ONE POWER SOURCE WITH SEPARATE DISCONNECTS. DISCONNECT ALL POWER SOURCES BEFORE SERVICING.

3.13 IDENTIFICATION OF HARDWARE AND WIRING

- A. All wiring and cabling, including that within factory-fabricated panels shall be labeled at each end within 5 cm (2 in.) of termination with control system address or termination number.
- B. All pneumatic tubing shall be labeled at each end within 5 cm (2 in.) of termination with a descriptive identifier.
- C. Permanently label or code each point of field terminal strips to show the instrument or item served.
- D. Identify control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.
- E. Identify all other control components with permanent labels. All plug-in components shall be labeled such that label removal of the component does not remove the label.
- F. Identify room sensors related to terminal boxes or valves with nameplates.
- G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
- H. Identifiers shall match record documents.

3.14 CONTROLLERS

- A. Provide a separate controller for each AHU or other HVAC system. A DDC controller may control more than one system provided that all points associated with the system are assigned to the same DDC controller. Points used for control loop reset, such as outside air or space temperature, are exempt from this requirement.
- B. Building Controllers and Custom Application Controllers shall be selected to provide the required I/O point capacity required to monitor all of the hardware points listed in Section 23 09 93 (Sequences of Operation).

3.15 PROGRAMMING

- A. Provide sufficient internal memory for the specified sequences of operation and trend logging.
- B. Point Naming. Name points as shown on the equipment points list provided with each sequence of operation. See Section 23 09 93 (Sequences of Operation). If character limitations or space restrictions make it advisable to shorten the name, the abbreviations given in Appendix B to Section 23 09 93 may be used. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, "Zone Temp 1" for Zone 1, "Zone Temp 2" for Zone 2.
- C. Software Programming.

1. Provide programming for the system and adhere to the sequences of operation provided. All other system programming necessary for the operation of the system, but not specified in this document, also shall be provided by the contractor. Embed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:
 - a. Text-based:
 - 1) Must provide actions for all possible situations
 - 2) Must be modular and structured
 - 3) Must be commented
 - b. Graphic-based:
 - 4) Must provide actions for all possible situations
 - 5) Must be documented
 - c. Parameter-based:
 - 6) Must provide actions for all possible situations
 - 7) Must be documented.
- D. Operator Interface.
1. Standard Graphics. Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all relevant input and output points for that equipment. Also show relevant calculated points such as setpoints. As a minimum, show on each equipment graphic the input and output points and relevant calculated points as indicated on the applicable Points List in Section 23 09 93.
 2. The contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and its functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.

3.16 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Startup Testing. All testing listed in this article shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified of the system demonstration.
1. The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
 2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
 3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturers' recommendations.
 4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
 5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and

- closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.
6. Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops.
 7. Alarms and Interlocks:
 - a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
 - b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
 - c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action

3.17 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Demonstration.
 1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.
 2. The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the "Control System Checkout and Testing" article in Part 3 of this specification. The engineer will be present to observe and review these tests. The engineer shall be notified at least 10 days in advance of the start of the testing procedures.
 3. The demonstration process shall follow that approved in Part 1, "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.
 4. The contractor shall provide at least two persons equipped with two-way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the contractor.
 5. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
 6. Demonstrate compliance with Part 1, "System Performance."
 7. Demonstrate compliance with sequences of operation through all modes of operation.
 8. Demonstrate complete operation of operator interface.
 9. Additionally, the following items shall be demonstrated:
 - a. DDC loop response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled

variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.

- b. Demand limiting. The contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
 - c. Optimum start/stop. The contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.
 - d. Interface to the building fire alarm system.
 - e. Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the architect/engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.
10. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

B. Acceptance.

- 1. All tests described in this specification shall have been performed to the satisfaction of both the engineer and owner prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the engineer. Such tests shall then be performed as part of the warranty.
- 2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1, "Submittals."

3.18 CLEANING

- A. The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.
- B. At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.
- C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.19 TRAINING

- A. Provide training for a designated staff of Owner's representatives. Training shall be provided via self-paced training, web-based or computer-based training, classroom training, or a combination of training methods.
- B. Training shall enable students to accomplish the following objectives.
 - 1. Day-to-day Operators:
 - a. Proficiently operate the system

- b. Understand control system architecture and configuration
- c. Understand DDC system components
- d. Understand system operation, including DDC system control and optimizing routines (algorithms)
- e. Operate the workstation and peripherals
- f. Log on and off the system
- g. Access graphics, point reports, and logs
- h. Adjust and change system set points, time schedules, and holiday schedules
- i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
- j. Understand system drawings and Operation and Maintenance manual
- k. Understand the job layout and location of control components
- l. Access data from DDC controllers and ASCs
- m. Operate portable operator's terminals
- 2. Advanced Operators:
 - a. Make and change graphics on the workstation
 - b. Create, delete, and modify alarms, including annunciation and routing of these
 - c. Create, delete, and modify point trend logs and graph or print these both on an ad-hoc basis and at user-definable time intervals
 - d. Create, delete, and modify reports
 - e. Add, remove, and modify system's physical points
 - f. Create, modify, and delete programming
 - g. Add panels when required
 - h. Add operator interface stations
 - i. Create, delete, and modify system displays, both graphical and others
 - j. Perform DDC system field checkout procedures
 - k. Perform DDC controller unit operation and maintenance procedures
 - l. Perform workstation and peripheral operation and maintenance procedures
 - m. Perform DDC system diagnostic procedures
 - n. Configure hardware including PC boards, switches, communication, and I/O points
 - o. Maintain, calibrate, troubleshoot, diagnose, and repair hardware
 - p. Adjust, calibrate, and replace system components
- 3. System Managers/Administrators:
 - a. Maintain software and prepare backups
 - b. Interface with job-specific, third-party operator software
 - c. Add new users and understand password security procedures
- C. Organize the training into sessions or modules for the three levels of operators listed above. (Day-to-Day Operators, Advanced Operators, System Managers and Administrators). Students will receive one or more of the training packages, depending on knowledge level required.
- D. Provide course outline and materials according to the "Submittals" article in Part 1 of this specification. Provide one copy of training material per student.
- E. The instructor(s) shall be factory-trained and experienced in presenting this material.
- F. Classroom training shall be done using a network of working controllers representative of installed hardware.

3.20 SEQUENCES OF OPERATION

- A. See Section 23 09 93, Sequences of Operation for HVAC Controls

3.21 CONTROL VALVE INSTALLATION

- A. Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with pipe design.
- B. Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position. Ball type control valves shall be installed with the stem in the horizontal position.
- C. Valves shall be installed in accordance with the manufacturer's recommendations.
- D. Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.
- E. Isolation valves shall be installed so that the control valve body may be serviced without draining the supply/return side piping system. Unions shall be installed at all connections to screw-type control valves.
- F. Provide tags for all control valves indicating service and number. Tags shall be brass, 1.5 inch in diameter, with ¼ inch high letters. Securely fasten with chain and hook. Match identification numbers as shown on approved controls shop drawings.

3.22 CONTROL DAMPER INSTALLATION

- A. Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.
- B. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure ¼ in. larger than damper dimensions and shall be square, straight, and level.
- C. Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be within 0.3 cm (1/8 in.) of each other.
- D. Follow the manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
- E. Install extended shaft or jackshaft according to manufacturer's instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)
- F. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to ensure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
- G. Provide a visible and accessible indication of damper position on the drive shaft end.
- H. Support ductwork in area of damper when required to prevent sagging due to damper weight.
- I. After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

3.23 DUCT SMOKE DETECTION

- A. Submit data for coordination of duct smoke detector interface to HVAC systems as required in Part 1, "Submittals."
- B. This Contractor shall provide a dry-contact alarm output in the same room as the HVAC equipment to be controlled.

3.24 PACKAGED EQUIPMENT CONTROLS

- A. General. The electronic controls packaged with any equipment furnished under this contract shall communicate with the building direct digital control (DDC) system. The DDC system shall communicate with these controls to read the information and change the control setpoints as shown in the points list, sequences of operation, and control schematics. The information to be communicated between the DDC system and these controls shall be in the standard object format as defined in ANSI/ASHRAE Standard 135 (BACnet). Controllers shall communicate with other BACnet objects on the internetwork using the Read (Execute) Property service as defined in Clause 15.5 of Standard 135.
- B. Distributed Processing. The controller shall be capable of stand-alone operation and shall continue to provide control functions if the network connection is lost.
- C. I/O Capacity. The controller shall contain sufficient I/ O capacity to control the target system.
- D. The Controller shall have a physical connection for a laptop computer or a portable operator's tool.
- E. Environment. The hardware shall be suitable for the anticipated ambient conditions.
 - 1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at 40°C to 60°C (40°F to 140°F).
 - 2. Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).
- F. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
- G. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 30 days.
- H. Power. Controller shall be able to operate at 90% to 110% of nominal voltage rating.
- I. Transformer. Power supply for the Controller must be rated at minimum of 125% of ASC power consumption and shall be fused or current limiting type.

3.25 START-UP AND CHECKOUT PROCEDURES

- A. Start up, check out, and test all hardware and software and verify communication between all components.
 - 1. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
 - 2. Verify that all analog and binary input/output points read properly.
 - 3. Verify alarms and interlocks.
 - 4. Verify operation of the integrated system.

APPENDIX A: Glossary of Terms

Terms used within the Specification Text:

- **Advanced Application Controller (AAC):**

A fully programmable control module. This control module may be capable of some of the advanced features found in Building Controllers (storing trends, initiating read and write requests, etc.) but it does not serve as a master controller. Advanced Application Controllers may reside on either the Ethernet/IP backbone or on a subnet.

- **Application Specific Controller (ASC):**

A pre-programmed control module which is intended for use in a specific application. ASCs may be configurable, in that the user can choose between various pre-programmed options, but it does not support full custom programming. ASCs are often used on terminal equipment such as VAV boxes or fan coil units. In many vendors' architectures ASCs do not store trends or schedules but instead rely upon a Building Controller to provide those functions.

- **BACnet/IP:**

An approved BACnet network type which uses an Ethernet carrier and IP addressing.

- **BACnet MS/TP:**

An approved BACnet network type which uses a Master-Slave Token Passing configuration. MS/TP networks are unique to BACnet and utilize EIA485 twisted pair topology running at 9600 to 76,800 bps.

- **BACnet over ARCNET:**

An approved BACnet network type which uses an ARCNET (attached resource computer network) carrier. ARCNET is an industry standard that can utilize several speeds and wiring standards. The most common configuration used by BACnet controllers is an EIA485 twisted pair topology running at 156,000 bps.

- **Building Controller (BC):**

A fully programmable control module which is capable of storing trends and schedules, serving as a router to devices on a subnet, and initiating read and write requests to other controllers. Typically this controller is located on the Ethernet/IP backbone of the BAS. In many vendors' architectures a Building Controller will serve as a master controller, storing schedules and trends for controllers on a subnet underneath the Building Controller.

- **Direct Digital Control (DDC):**

A control system in which a digital computer or microprocessor is directly connected to the valves, dampers, and other actuators which control the system, as opposed to indirectly controlling a system by resetting setpoints on an analog pneumatic or electronic controller.

- **PICS - Protocol Implementation Conformance Statement:**

A written document, created by the manufacturer of a device, which identifies the particular options specified by BACnet that are implemented in the device.

- **Smart Actuator (SA):**

An actuator which is controlled by a network connection rather than a binary or analog signal. (0-10v, 4-

20mA, relay, etc.)

- **Smart Sensor (SS):**

A sensor which provides information to the BAS via network connection rather than a binary or analog signal. (0-10000 ohm, 4-20mA, dry contact, etc.)

- **Web services:**

Web services are a standard method of exchanging data between computer systems using the XML (extensible markup language) and SOAP (simple object access protocol) standards. Web services can be used at any level within a Building Automation System (BAS), but most commonly they are used to transfer data between BAS using different protocols or between a BAS and a non-BAS system such as a tenant billing system or a utility management system.

Terms used within the Sequences of Operation:

- **adj.**
Adjustable by the end user, through the supplied user interface.

- **AI, AO, etc. (Column Headings on Points List)**

AI = Analog Input. A physical input to the control module.

AO = Analog Output. A physical output from the control module.

AV = Analog Value. An intermediate (software) point that may be editable or read-only. Editable AVs are typically used to allow the user to set a fixed control parameter, such as a setpoint. Read Only AVs are typically used to display the status of a control operation.

BI = Binary Input. A physical input to the control module.

BO = Binary Output. A physical output from the control module.

BV = Binary Value. An intermediate (software) point that may be editable or read-only. Editable BVs are typically used to allow the user to set a fixed control parameter, such as a setpoint. Read Only BVs are typically used to display the status of a control operation.

Loop = A control loop. Most commonly a PID control loop. Typically a control loop will include a setpoint, an input which is compared to the setpoint, and an output which controls some action based upon the difference between the input and the setpoint. A PID control loop will also include gains for the proportional, integral, and derivative response as well as an interval which controls how frequently the control loop updates its output. These gains may be adjustable by the end user for control loop "tuning," but in self-tuning control loops or loops which have been optimized for a specific application the gains may not be adjustable.

Sched = Schedule. The control algorithm for this equipment shall include a user editable schedule.

Trend. The control system shall be configured to collect and display a trend log of this object. The trending interval shall be no less than one sample every 5 minutes. (Change of Value trending, where a sample is taken every time the value changes by more than a user-defined minimum, is an acceptable alternative.)

Alarm. The control system shall be configured to generate an alarm when this object exceeds user definable limits, as described in the Sequence of Controls.

Note: If the specifications require use of the BACnet protocol, all of the above shall be provided as BACnet objects.

- **KW Demand Limiting: ***

An energy management strategy that reduces energy consumption when a system's electric power meter exceeds an operator-defined threshold.

When power consumption exceeds defined levels, the system automatically adjust setpoints, de-energizes low priority equipment, and takes other pre-programmed actions to avoid peak demand charges. As the demand drops, the system restores loads in a predetermined manner.

- **Occupant Override Switch, or Timed Local Override:**

A control option that allows building occupants to override the programmed HVAC schedule for a limited period of time.

When the override time expires, the zone returns to its unoccupied state.

- **Occupant Setpoint Adjustment:**

A control option that allows building occupants to adjust - within limits set by the HVAC control system - the heating and cooling setpoints of selected zones. Typically the user interface for this function is built into the zone sensor.

- **Optimal Start-Up: ***

A control strategy that automatically starts an HVAC system at the latest possible time yet ensures comfort conditions by the time the building becomes occupied.

In a typical implementation, a controller measures the temperature of the zone and the outside air. Then, using design heating or cooling capacity at the design outside air temperature, the system computes how long a unit must run at maximum capacity to bring the zone temperature to its occupied setpoint.

The optimal start algorithm often includes a self-learning feature to adjust for variations from design capacity.

A distributed system must use Run on Request with Optimal Start. (See below.)

- **Requested, or Run on Request: ***

A control strategy that optimizes the runtime of a source piece of equipment that supplies one or more receiving units - such as an air handler unit supplying zone terminal units with heating, cooling, ventilation, or similar service. Source equipment runs only when needed, not on a fixed schedule.

The source equipment runs when one or more receiving units request its services. An operator

determines how many requests are required to start the source equipment.

For example, if all the zones in a building are unoccupied and the zone terminal units do not need heating or cooling, the AHU will shut down. However, if a zone becomes occupied or needs cooling, the terminal unit will send a run request to the AHU to initiate the start-up sequence. If this AHU depends on a central chiller, it can send a run request to the chiller.

The run on request algorithm also allows an operator to schedule occupancy for individual zones based on the needs of the occupants without having to adjust the schedules of related AHUs and chillers.

- **Trim and Respond, or Setpoint Optimization: ***

A control strategy that optimizes the setpoint of a source piece of equipment that supplies one or more receiving units - such as an air handler unit supplying zone terminal units with heating, cooling, ventilation, or similar service.

The source unit communicates with receiving units to determine heating, cooling, and other requirements, and then adjusts its setpoint.

For example, if all zones are comfortable and do not request cooling, the AHU will gradually increase (trim) its supply air setpoint. When a zone requests cooling, the AHU responds by dropping its setpoint. The more zones that request cooling, the more it drops the setpoint. The AHU repeats this process throughout the day to keep zones cool, but with a supply air setpoint that is no cooler than necessary.

Contracting Terms:

- **Furnished or Provided:**

The act of supplying a device or piece of equipment as required meeting the scope of work specified and making that device or equipment operational. All costs required to furnish the specified device or equipment and make it operational are borne by the division specified to be responsible for providing the device or equipment.

- **Install or Installed:**

The physical act of mounting, piping or wiring a device or piece of equipment in accordance with the manufacturer's instructions and the scope of work as specified. All costs required to complete the installation are borne by the division specified to include labor and any ancillary materials.

- **Interface:**

The physical device required to provide integration capabilities from an equipment vendor's product to the control system. The equipment vendor most normally furnishes the interface device. An example of an interface is the chilled water temperature reset interface card provided by the chiller manufacturer in order to allow the control system to integrate the chilled water temperature reset function into the control system.

- **Integrate:**

The physical connections from a control system to all specified equipment through an interface as required to allow the specified control and monitoring functions of the equipment to be performed via the control system.

APPENDIX B: Abbreviations

The following abbreviations may be used in graphics, schematics, point names, and other UI applications where space is at a premium.

AC - Air Conditioning	HTEX - Heat Exchanger
ACU - Air Conditioning Unit	HW - Hot Water
AHU - Air Handling Unit	HWP - Hot Water Pump
AI - Analog Input	HWR - Hot Water Return
AO - Analog Output	HWS - Hot Water Supply
AUTO - Automatic	MAX - Maximum
AUX - Auxiliary	MIN - Minimum
BI - Binary Input	MISC - Miscellaneous
BO - Binary Output	NC - Normally Closed
C - Common	NO - Normally Open
CHW - Chilled Water	OA - Outdoor Air
CHWP - Chilled Water Pump	PIU - Powered Induction Unit
CHWR - Chilled Water Return	RA - Return Air
CHWS - Chilled Water Supply	RF - Return Fan
COND - Condenser	RH - Relative Humidity
CW - Condenser Water	RTU - Roof-top Unit
CWP - Condenser Water Pump	SA - Supply Air
CWR - Condenser Water Return	SF - Supply Fan
CWS - Condenser Water Supply	SP - Static Pressure
DA - Discharge Air	TEMP - Temperature
EA - Exhaust Air	UH - Unit Heater
EF - Exhaust Fan	UV - Unit Ventilator
EVAP - Evaporators	VAV - Variable Air Volume
FCU - Fan Coil Unit	VVTU - Variable Volume Terminal Unit
HOA - Hand / Off / Auto	W/ - with
HP - Heat Pump	W/O - without
HRU - Heat Recovery Unit	WSHP - Water Source Heat Pump

END OF SECTION

SECTION 230993
SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.1 CONTROL

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. All HVAC Systems shall be controlled with Direct Digital Control (DDC) according to the point list contained in this section of the specifications and shall be stand-alone. Additional points or software programming not listed in the point list but which are required to meet the following sequences of operation shall be provided.

1.2 SETPOINTS

- A. All setpoints shall be adjustable. All control loops shall utilize PI² or PID control algorithms unless otherwise specified in the sequence of operation.

1.3 HEATING WATER SYSTEM (HX-1,P-1,P-2)

Heat Exchanger System Run Conditions:

The heat exchanger system shall be enabled to run whenever:

- A definable number of hot water coils need heating.
- AND outside air temperature is less than 65°F (adj.).

To prevent short cycling, the heat exchanger shall run for and be off for minimum adjustable times (both user definable).

The heat exchanger system shall also run for freeze protection whenever outside air temperature is less than 38°F (adj.)

Hot Water Pump Lead/Standby Operation:

The two hot water pumps shall operate in a lead/standby fashion.

- The lead pump shall run first.
- On failure of the lead pump, the standby pump shall run and the lead pump shall turn off.

The designated lead pump shall rotate upon one of the following conditions (user selectable):

- manually through a software switch
- if pump runtime (adj.) is exceeded
- daily
- weekly
- monthly

Alarms shall be provided as follows:

- Hot Water Pump 1
 - Failure: Commanded on, but the status is off.
 - Running in Hand: Commanded off, but the status is on.
 - VFD Fault.
- Hot Water Pump 2

- Failure: Commanded on, but the status is off.
- Running in Hand: Commanded off, but the status is on.
- VFD Fault.

Hot Water Differential Pressure Control:

The controller shall measure hot water differential pressure and modulate the hot water pump VFD to maintain its hot water differential pressure setpoint via the pump integrated VFD. Some control functions may be performed by the VFD and not the controller. The DDC contractor shall coordinate with the pump manufacturer to achieve the desired sequence.

The following setpoints are recommended values. All setpoints shall be field adjusted during the commissioning period to meet the requirements of actual field conditions.

The controller shall modulate hot water pump speed to maintain a hot water differential pressure of 12lbf/in² (adj.). The VFDs minimum speed shall not drop below 20% (adj.).

The controller shall modulate the bypass valve to maintain the hot water flow at the VFD minimum speed when there is a call for heat under low load conditions.

Alarms shall be provided as follows:

- High Hot Water Differential Pressure: If 25% (adj.) greater than setpoint.
- Low Hot Water Differential Pressure: If 25% (adj.) less than setpoint.

Hot Water Supply Temperature Setpoint Reset:

The hot water supply temperature setpoint shall reset based on outside air temperature.

As outside air temperature rises from 0°F (adj.) to 70°F (adj.) the hot water supply temperature setpoint shall reset downwards from 180°F (adj.) to 110°F (adj.).

Alarms shall be provided as follows:

- High Hot Water Supply Temp: If greater than 200°F (adj.).
- Low Hot Water Supply Temp: If less than 100°F (adj.).

Heat Exchanger Steam Valves - Hot Water Control:

The controller shall measure the hot water supply temperature and modulate the two steam valves in sequence to maintain its setpoint.

The steam valves shall be enabled whenever:

- The heat exchanger is called to run.
- AND hot water supply temperature is below setpoint.

The steam valves shall open to 100% (adj.) whenever the heat exchanger is in freeze protection due to low outside air temperature.

The steam valves shall close whenever the hot water supply temperature rises from 180°F to 190°F (adj.).

	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
Hot Water Differential Pressure	x								x		x
Hot Water Return Temp	x								x		x
Hot Water Supply Temp	x								x		x
Hot Water Pump 1 VFD Speed		x							x		x
Hot Water Pump 2 VFD Speed		x							x		x
Steam Valve 1/3		x							x		x
Steam Valve 2/3		x							x		x
Hot Water Pump 1 Status			x						x		x
Hot Water Pump 1 VFD Fault			x							x	x
Hot Water Pump 2 Status			x						x		x
Hot Water Pump 2 VFD Fault			x							x	x
Hot Water Pump 1 Start/Stop				x							x
Hot Water Pump 2 Start/Stop				x							x
Hot Water Differential Pressure Setpoint					x						x
Hot Water Supply Temp Setpoint					x				x		x
Outside Air Temp					x						x
High Hot Water Differential Pressure										x	
High Hot Water Supply Temp										x	
Hot Water Pump 1 Failure										x	
Hot Water Pump 1 Running in Hand										x	
Hot Water Pump 2 Failure										x	
Hot Water Pump 2 Running in Hand										x	
Low Hot Water Differential Pressure										x	
Low Hot Water Supply Temp										x	
Totals	3	4	4	2	3	0	0	0	10	12	16

Total Hardware (13)

Total Software (25)

1.4 AH-1,2 (typical of 2)

Run Conditions - Scheduled:

The unit shall run based on an operator adjustable schedule.

Freeze Protection:

The unit shall shut down and generate an alarm upon receiving a freezestat status.

High Static Shutdown:

The unit shall shut down and generate an alarm upon receiving an high static shutdown signal.

Return Air Smoke Detection:

The unit shall shut down and generate an alarm upon receiving a return air smoke detector status.

Supply Fan:

The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime.

Alarms shall be provided as follows:

- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan in Hand: Commanded off, but the status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Supply Air Duct Static Pressure Control:

The controller shall measure duct static pressure and shall modulate the supply fan speed to maintain a duct static pressure setpoint of 1.5in H2O (adj.). The supply fan speed shall not drop below 30% (adj.).

Alarms shall be provided as follows:

- High Supply Air Static Pressure: If the supply air static pressure is 25% (adj.) greater than setpoint.
- Low Supply Air Static Pressure: If the supply air static pressure is 25% (adj.) less than setpoint.
- Supply Fan VFD Fault.

Return Fan:

The return fan shall run whenever the supply fan runs.

Alarms shall be provided as follows:

- Return Fan Failure: Commanded on, but the status is off.
- Return Fan in Hand: Commanded off, but the status is on.
- Return Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).
- Return Fan VFD Fault.

Return Plenum Static Pressure Control:

The controller shall measure return plenum static pressure and modulate the return fan VFD speed to maintain a return plenum static pressure setpoint of 0.2in H2O (adj.). The return fan VFD speed shall not drop below 20% (adj.).

Alarms shall be provided as follows:

- High Return Plenum Static Pressure: If the return air plenum static pressure is 25% (adj.) greater than setpoint.
- Low Return Plenum Static Pressure: If the return air plenum static pressure is 25% (adj.) less than setpoint.

Supply Air Temperature Setpoint - Optimized:

The controller shall monitor the supply air temperature and shall maintain a supply air temperature setpoint reset based on zone cooling and heating requirements

The supply air temperature setpoint shall be reset for cooling based on zone cooling requirements as follows:

- The initial supply air temperature setpoint shall be 55°F (adj.).
- As cooling demand increases, the setpoint shall incrementally reset down to a minimum of 53°F (adj.).
- As cooling demand decreases, the setpoint shall incrementally reset up to a maximum of 72°F (adj.).

If more zones need heating than cooling, then the supply air temperature setpoint shall be reset for heating as follows:

- The initial supply air temperature setpoint shall be 82°F (adj.).
- As heating demand increases, the setpoint shall incrementally reset up to a maximum of 85°F (adj.).
- As heating demand decreases, the setpoint shall incrementally reset down to a minimum of 72°F (adj.).

Cooling Coil Valve:

The controller shall measure the supply air temperature and modulate the cooling coil valve to maintain its cooling setpoint.

The cooling shall be enabled whenever:

- Outside air temperature is greater than 60°F (adj.).
- AND the economizer (if present) is disabled or fully open.
- AND the supply fan status is on.
- AND the heating (if present) is not active.

The cooling coil valve shall open to 50% (adj.) whenever the freezestat (if present) is on.

Alarms shall be provided as follows:

- High Supply Air Temp: If the supply air temperature is 5°F (adj.) greater than setpoint.

Heating Coil Valve:

The controller shall measure the supply air temperature and modulate the heating coil valve to maintain its heating setpoint.

The heating shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).

- AND the supply fan status is on.
- AND the cooling (if present) is not active.

The heating coil valve shall open whenever:

- Supply air temperature drops from 40°F to 35°F (adj.).
- OR the freezestat (if present) is on.

Alarms shall be provided as follows:

- Low Supply Air Temp: If the supply air temperature is 5°F (adj.) less than setpoint.

Economizer:

The controller shall measure the mixed air temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F (adj.) less than the supply air temperature setpoint. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open whenever occupied.

The economizer shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the outside air temperature is less than the return air temperature.
- AND the supply fan status is on.

The economizer shall close whenever:

- Mixed air temperature drops from 40°F to 35°F (adj.).
- OR the freezestat (if present) is on.
- OR on loss of supply fan status.

The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off. If Optimal Start Up is available the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.

Minimum Outside Air Ventilation - Carbon Dioxide (CO2) Control:

When in the occupied mode, the controller shall measure the return air CO2 concentration and modulate the outside air dampers open on rising CO2 concentrations to maintain a CO2 setpoint of 750 ppm (adj.). Dampers shall modulate between the scheduled outside air volume and minimum outside air volume. Do not exceed the outside air volume except during economizer operation.

Mixed Air Temperature:

The controller shall monitor the mixed air temperature and use as required for economizer control (if present) or preheating control (if present).

Alarms shall be provided as follows:

- High Mixed Air Temp: If the mixed air temperature is greater than 90°F (adj.).
- Low Mixed Air Temp: If the mixed air temperature is less than 45°F (adj.).

Return Air Carbon Dioxide (CO2) Concentration Monitoring:

The controller shall measure the return air CO2 concentration.

Alarms shall be provided as follows:

- High Return Air Carbon Dioxide Concentration: If the return air CO2 concentration is greater than 1000ppm (adj.) when in the unit is running.

Return Air Temperature:

The controller shall monitor the return air temperature and use as required for setpoint control or economizer control (if present).

Alarms shall be provided as follows:

- High Return Air Temp: If the return air temperature is greater than 90°F (adj.).
- Low Return Air Temp: If the return air temperature is less than 45°F (adj.).

Supply Air Temperature:

The controller shall monitor the supply air temperature.

Alarms shall be provided as follows:

- High Supply Air Temp: If the supply air temperature is greater than 120°F (adj.).
- Low Supply Air Temp: If the supply air temperature is less than 45°F (adj.).

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Mixed Air Temp	x								x		x
Outside Airflow	x								x	x	x
Return Air Carbon Dioxide PPM	x								x		x
Return Air Temp	x								x		x
Return Plenum Static Pressure	x								x		x
Supply Air Static Pressure	x								x	x	x
Supply Air Temp	x								x		x
Cooling Valve		x							x		x
Heating Valve		x							x		x
Mixed Air Dampers		x							x		x
Return Fan VFD Speed		x							x		x
Supply Fan VFD Speed		x							x		x
Freezestat			x						x	x	x
High Static Shutdown			x						x	x	x
Return Air Smoke Detector			x						x	x	x
Return Fan Status			x						x		x
Return Fan VFD Fault			x							x	x
Supply Fan Status			x						x		x
Supply Fan VFD Fault			x							x	x
Return Fan Start/Stop				x					x		x
Supply Fan Start/Stop				x					x		x

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Economizer Mixed Air Temp Setpoint					x				x		x
Outside Airflow Setpoint					x				x		x
Return Air Carbon Dioxide PPM Setpoint					x				x		x
Return Plenum Static Pressure Setpoint					x				x		x
Supply Air Static Pressure Setpoint					x				x		x
Supply Air Temp Setpoint					x				x		x
High Mixed Air Temp										x	
High Return Air Carbon Dioxide Concentration										x	
High Return Air Temp										x	
High Return Plenum Static Pressure										x	
High Supply Air Static Pressure										x	
High Supply Air Temp										x	
High Supply Air Temp										x	
Low Mixed Air Temp										x	
Low Return Air Temp										x	
Low Return Plenum Static Pressure										x	
Low Supply Air Static Pressure										x	
Low Supply Air Temp										x	
Low Supply Air Temp										x	
Return Fan Failure										x	
Return Fan in Hand										x	
Return Fan Runtime Exceeded										x	
Supply Fan Failure										x	
Supply Fan in Hand										x	
Supply Fan Runtime Exceeded										x	
Totals	7	5	7	2	6	0	0	0	25	26	27

Total Hardware (21)

Total Software (57)

1.5 Variable Air Volume Boxes (TU) (typical of 18)

Run Conditions - Scheduled:

The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
 - A 75°F (adj.) cooling setpoint
 - A 70°F (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit shall maintain
 - A 85°F (adj.) cooling setpoint.
 - A 55°F (adj.) heating setpoint.

Alarms shall be provided as follows:

- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

Reversing Variable Volume Terminal Unit - Flow Control:

The unit shall maintain zone setpoints by controlling the airflow through one of the following:

Occupied:

- When zone temperature is greater than its cooling setpoint, the zone damper shall modulate between the minimum occupied airflow (adj.) and the maximum cooling airflow (adj.) until the zone is satisfied.
- When the zone temperature is between the cooling setpoint and the heating setpoint, the zone damper shall maintain the minimum required zone ventilation (adj.).
- When zone temperature is less than its heating setpoint, the controller shall enable heating to maintain the zone temperature at its heating setpoint. Additionally, if warm air is available from the AHU, the zone damper shall modulate between the minimum occupied airflow (adj.) and the maximum heating airflow (adj.) until the zone is satisfied.

Unoccupied:

- When the zone is unoccupied the zone damper shall control to its minimum unoccupied airflow (adj.).
- When the zone temperature is greater than its cooling setpoint, the zone damper shall modulate between the minimum unoccupied airflow (adj.) and the maximum cooling airflow (adj.) until the zone is satisfied.

- When zone temperature is less than its unoccupied heating setpoint, the controller shall enable heating to maintain the zone temperature at the setpoint. Additionally, if warm air is available from the AHU, the zone damper shall modulate between the minimum unoccupied airflow (adj.) and the auxiliary heating airflow (adj.) until the zone is satisfied.

Reheating Coil Valve:

The controller shall measure the zone temperature and modulate the reheating coil valve open on dropping temperature to maintain its heating setpoint.

When cold air is available from the AHU and there is no fan present in the box, the zone damper shall modulate to the minimum occupied airflow (adj.). If more heat is required, the zone damper shall modulate to the auxiliary heating airflow (adj.).

Discharge Air Temperature:

The controller shall monitor the discharge air temperature.

Alarms shall be provided as follows:

- High Discharge Air Temp: If the discharge air temperature is greater than 120°F (adj.).
- Low Discharge Air Temp: If the discharge air temperature is less than 40°F (adj.).

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Airflow	x								x		x
Discharge Air Temp	x								x		x
Zone Setpoint Adjust	x										x
Zone Temp	x								x		x
Reheating Valve		x							x		x
Zone Damper		x							x		x
Airflow Setpoint					x				x		x
Cooling Setpoint					x				x		x
Heating Setpoint					x				x		x
Heating Mode						x			x		
Schedule								x			
High Discharge Air Temp										x	
High Zone Temp										x	
Low Discharge Air Temp										x	
Low Zone Temp										x	
Totals	4	2	0	0	3	1	0	1	9	4	9

Per TU: Total Hardware (6)

Total Software (18)

1.6 CONVECTOR/FIN TUBE (C & BB)

Run Conditions – Continuous:

The unit shall run continuously and shall maintain a heating setpoint of 70 deg. F (adj.).

Heating Control Valve:

The controller shall measure the zone temperature and modulate the heating coil valve to maintain its heating setpoint.

The heating shall be enabled whenever:

- Outside air temperature is less then 65deg. F (adj.)
- AND the zone temperature is below heating setpoint.

Alarms shall be provided as follows:

- Low Zone Temp.

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Zone Temp	x								x		x
Heating Valve		x							x		x
Heating Setpoint					x				x		x
Low Zone Temp										x	
Totals	1	1	0	0	1	0	0	0	3	1	3

Per unit: Total Hardware (2)

Total Software (8)

1.7 EXHAUST FANS (EF)

Run Conditions - Scheduled:

The fan shall run according to a user definable schedule.

Fan Status:

The controller shall monitor the fan status.

Alarms shall be provided as follows:

- Fan Failure: Commanded on, but the status is off.
- Fan in Hand: Commanded off, but the status is on.

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Fan Status			x						x		x
Fan Start/Stop				x					x		x
Schedule								x			
Fan Failure										x	

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Fan in Hand										x	
Totals	0	0	1	1	0	0	0	1	2	2	2

Per EF: Total Hardware (3)

Total Software (7)

1.8 BTU METER – STEAM

BTU Meter:

The controller shall monitor the BTU meter for energy consumption on a continual basis. These values shall be made available to the system at all times.

Alarm shall be generated as follows:

- Invalid Reading: Sensor reading indicates an invalid value from the BTU meter.

Peak Demand History:

The controller shall monitor and record the peak (high and low) demand readings from the BTU meter. Peak readings shall be recorded on a daily, month-to-date, and year-to-date basis.

Usage History:

The controller shall monitor and record BTU meter readings so as to provide an energy consumption history. Usage readings shall be recorded on a daily, month-to-date, and year-to-date basis.

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Meter Input	x										
Demand					x				x		x
Peak Month-to-Date									x		x
Peak Today									x		x
Peak Year-to-Date									x		x
Usage Month-to-Date									x		x
Usage Today									x		x
Usage Year-to-Date									x		x
Invalid Value										x	
Totals	1	0	0	0	1	0	0	0	7	1	7

Total Hardware (1)

Total Software (9)

1.9 BTU METER – CHILLED WATER

Chilled Water Cooling Demand - Energy Meter:

The controller shall monitor the chilled water supply temperature, chilled water return temperature and chilled water flow to the building and calculate current energy demand on a continual basis. These values shall be made available to the system at all times.

Alarm shall be generated as follows:

- Invalid Reading: Sensor readings indicate an invalid demand value.

Peak Demand History:

The controller shall monitor and record the peak (high and low) demand readings from the chilled water energy meter. Peak readings shall be recorded on a daily, month-to-date, and year-to-date basis.

Usage History:

The controller shall monitor and record chilled water energy meter readings so as to provide an energy consumption history. Usage readings shall be recorded on a daily, month-to-date, and year-to-date basis.

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Chilled Water Flow	x								x		x
Chilled Water Return Temp	x								x		x
Chilled Water Supply Temp	x								x		x
Demand					x				x		x
Peak Month-to-Date									x		x
Peak Today									x		x
Peak Year-to-Date									x		x
Usage Month-to-Date									x		x
Usage Today									x		x
Usage Year-to-Date									x		x
Totals	3	0	0	0	1	0	0	0	10	0	10

Total Hardware (3) **Total Software (11)**

1.10 CONDENSATE FLOWMETER

Water Meter:

The controller shall monitor the water meter for water consumption on a continual basis. These values shall be made available to the system at all times.

Alarm shall be generated as follows:

- Invalid Reading: Sensor reading indicates an invalid value from the water meter.

Peak Demand History:

The controller shall monitor and record the peak (high and low) demand readings from the water meter. These readings shall be recorded on a daily, month-to-date, and year-to-date basis.

Usage History:

The controller shall monitor and record water meter readings so as to provide a water consumption history. Usage readings shall be recorded on a daily, month-to-date, and year-to-date basis.

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Water Flow Rate	x										
Demand									x		x

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Peak Month-to-Date									x		x
Peak Today									x		x
Peak Year-to-Date									x		x
Usage Month-to-Date									x		x
Usage Today									x		x
Usage Year-to-Date									x		x
Invalid Value										x	
Totals	1	0	0	0	0	0	0	0	7	1	7
Total Hardware (1)					Total Software (8)						

1.11 IT CLOSETS FC-1/CU-1 and FC-2/CU-2

The control system shall monitor the IT closet room temperature and provide an alarm if it exceeds the high limit set point.

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Zone Temp	x										x
High Zone Temp										x	
Totals	1	0	0	0	0	0	0	0	0	1	1
Total Hardware (1)					Total Software (1)						

1.12 OUTSIDE AIR CONDITIONS

Outside Air Conditions:

The controller shall monitor the outside air temperature and humidity and calculate the outside air enthalpy on a continual basis. These values shall be made available to the system at all times.

Alarm shall be generated as follows:

- Sensor Failure: Sensor reading indicates shorted or disconnected sensor. In the event of a sensor failure, an alternate outside air conditions sensor shall be made available to the system without interruption in sensor readings.

If an OA Temp Sensor cannot be read, a default value of 65°F will be used.

If an OA Humidity Sensor cannot be read, a default value of 50% will be used.

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Outside Air Humidity	x								x		x
Outside Air Temp	x								x		x
Outside Air Enthalpy					x				x		x
Outside Air Temp (Alternate)					x				x		
Sensor Failure										x	
Totals	2	0	0	0	2	0	0	0	4	1	3

Total Hardware (2)

Total Software (7)

1.13 DOMESTIC HOT WATER RECIRC PUMP

Run Conditions - Scheduled:

The pump shall run according to a user definable schedule.

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Pump Start/Stop				x					x		x
Schedule								x			
Totals	0	0	0	1	0	0	0	1	1	0	1

Total Hardware (1)

Total Software (2)

1.14 DOMESTIC WATER METER

Water Meter:

The controller shall monitor the water meter for water consumption on a continual basis. These values shall be made available to the system at all times.

Alarm shall be generated as follows:

- Meter Failure: Sensor reading indicates a loss of pulse output from the water meter.

Peak Demand History:

The controller shall monitor and record the peak (high and low) demand readings from the water meter. These readings shall be recorded on a daily, month-to-date, and year-to-date basis.

Usage History:

The controller shall monitor and record water meter readings so as to provide a water consumption history. Usage readings shall be recorded on a daily, month-to-date, and year-to-date basis.

Point Name	Hardware Points				Software Points						Show on Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Water Flow Rate	x										
Demand									x		x
Peak Today									x		x
Peak Month-to-Date									x		x
Peak Year-to-Date									x		x
Usage Today									x		x
Usage Moth-to-Date									x		x
Usage Year-to-Date									x		x
Meter Failure										x	
Totals	1	0	0	0	0	0	0	0	7	1	7
Total Hardware (1)					Total Software (8)						

END OF SECTION

SECTION 232116
HYDRONIC PIPING SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. Section Includes:
 - 1. Flexible connectors.
 - 2. Bladder-type expansion tanks.
 - 3. Air vents.
 - 4. Air separators.
 - 5. Strainers.
 - 6. Pump suction fittings.
 - 7. Flow controls.
 - 8. Relief valves.
 - 9. Braided flexible expansion loops.

1.2 PERFORMANCE REQUIREMENTS

- A. Flexible Connectors: Provide at or near pumps and other motorized equipment where piping configuration does not absorb vibration.

1.3 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Product Data: Submit for manufactured products and assemblies used in this Project.
 - 1. Manufacturer's data indicating use, operating range, total range, accuracy, and location for manufactured components.
 - 2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
 - 3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
 - 4. Submit electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.

1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for closeout procedures.
- B. Operation and Maintenance Data: Submit installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.5 MAINTENANCE SERVICE

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for maintenance service.

1.6 MAINTENANCE MATERIALS

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for spare parts and maintenance materials.

1.7 EXTRA MATERIALS

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for spare parts and maintenance products.

PART 2 PRODUCTS

2.1 FLEXIBLE CONNECTORS

- A. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure 300-psig.

2.2 BLADDER-TYPE EXPANSION TANKS

- A. Manufacturers:
 - 1. American Wheatley
 - 2. Amtrol, Inc.
 - 3. Armstrong Pumps, Inc.
 - 4. Bell & Gossett ITT; Fluid Handling Division.
 - 5. Grundfos
 - 6. MEPCO
 - 7. Taco, Inc.
- B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; Division 1, latest edition, with steel support stand. Tank shall incorporate a removable and replaceable heavy-duty butyl or EPDM bladder. Non-replaceable diaphragm type tanks are not acceptable.
- C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig unless noted otherwise on schedule.
- D. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow prevention device, test cocks, strainer, vacuum breaker, and water meter.

2.3 AIR VENTS

- A. Manufacturers:
 - 1. Armstrong Machine Works.
 - 2. Bell & Gossett ITT; Fluid Handling Division.
 - 3. Caleffi
 - 4. Hoffman Specialty ITT; Fluid Handling Division.
 - 5. Spirax Sarco.
 - 6. Taco, Inc.
 - 7. Watson McDaniel.
- B. Manual Type: Short vertical sections of 2-inch-diameter pipe to form air chamber, with 1/8-inch brass needle valve at top of chamber.
- C. Float Type:
 - 1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
- D. Washer Type:
 - 1. Brass with hydroscopic fiber disks, vent ports, adjustable cap for manual shutoff, and integral spring-loaded ball check valve.

2.4 AIR SEPARATORS

- A. Manufacturers:
 - 1. Grundfos
 - 2. American Wheatley
 - 3. Amtrol, Inc.

4. Armstrong Pumps, Inc.
 5. Bell & Gossett ITT; Fluid Handling Division.
 6. Caleffi
 7. Taco, Inc.
 8. John Wood Co.
 9. Weinman.
- B. Combination Air Separators/Strainers: Steel, tested and stamped in accordance with ASME Section VIII; for 125-psig operating pressure, with integral bronze strainer, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.5 STRAINERS

- A. Size 2 Inches and Smaller:
1. Screwed brass or iron body for 175-psig working pressure, Y pattern with 1/32-inch stainless steel perforated screen.
- B. Size 2-1/2 Inches to 4 Inches:
1. Flanged iron body for 175-psig working pressure, Y pattern with 3/64-inch stainless steel perforated screen.

2.6 PUMP SUCTION FITTINGS

- A. Manufacturers:
1. Grundfos
 2. Amtrol, Inc.
 3. Armstrong Pumps, Inc.
 4. Bell & Gossett ITT; Fluid Handling Division.
 5. Central Sprink, Inc.
 6. Taco, Inc.
 7. Victaulic Company of America.
- B. Fitting: Angle pattern, cast-iron body. Threaded for 2 inches and smaller, flanged for 2-1/2 inches and larger. Rated for 175-psig working pressure, with inlet vanes, cylinder strainer with 3/16-inch-diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.
- C. Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping inside.

2.7 FLOW CONTROLS

- A. Manufacturers:
1. Bell & Gossett.
 2. Armstrong.
 3. Taco.
 4. Wheatley.
 5. Tour & Anderson.
 6. Griswold Controls.
- B. Construction: Brass or bronze body with union on inlet, and outlet, temperature and pressure test plug on inlet and outlet combination blowdown and backflush drain.
- C. Calibration: Control within 5% of design flow over entire operating pressure.
- D. Control Mechanism: Stainless steel or nickel-plated brass piston or regulator cup, operating against stainless steel helical or wave-formed spring.
- E. Accessories: In-line strainer on inlet and ball valve on outlet.

2.8 RELIEF VALVES

- A. Manufacturers:
 - 1. Amtrol, Inc.
 - 2. Bell & Gossett ITT; Fluid Handling Division.
 - 3. Spirax Sarco.
 - 4. Watts Regulator Co.
 - 5. Conbraco.
 - 6. Kunkle.
 - 7. Watson McDaniel.
- B. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct-pressure actuated capacities ASME certified and labeled.

2.9 BRAIDED FLEXIBLE EXPANSION LOOPS

- A. Braided flexible expansion loops shall consist of two parallel sections of braided metal hose, a 180 degree return bend, with inlet and outlet 90-degree elbow connections. The loops shall be engineered to move in all three planes and shall impart no thrust loads to system anchors.
- B. Materials of construction of the braided metal hoses are to be a type 321 stainless steel with a type 304 stainless steel braid. End fittings shall be consistent with pipe material and connection fittings.
- C. Loops shall be designed to meet the design pressure, temperature, and movement requirements for the system. Loops shall be capable of accommodating piping system and equipment movements and vibration as needed.
- D. Loops shall be furnished with factory supplied hanger / support lug located at the bottom of the 180-degree return. Also provided at the bottom return will be a plugged FPT to be used for a drain or air release vent.

PART 3 EXECUTION

3.1 INSTALLATION - HYDRONIC PIPING SPECIALTIES

- A. Locate test plugs as indicated on Drawings.
- B. Where large air quantities accumulate, provide enlarged air collection standpipes.
- C. Install manual air vents at system high points.
- D. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain.
- E. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- F. Provide drain and hose connection with valve on strainer blowdown connection.
- G. Provide pump suction fitting on suction side of base-mounted centrifugal pumps. Remove temporary strainers after cleaning systems.
- H. Support pump fittings with floor-mounted pipe and flange supports.
- I. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
 - 1. Select system relief valve capacity greater than makeup pressure-reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
 - 2. Pipe relief valve outlet to nearest floor drain.
 - 3. Where one line vents several relief valves, make cross-sectional area equal to sum of individual vent areas.

3.2 FIELD QUALITY CONTROL

- A. Refer to Section, QUALITY REQUIREMENTS Section, EXECUTION AND CLOSEOUT REQUIREMENTS for field inspecting, testing, adjusting, and balancing.

3.3 CLEANING

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for cleaning requirements.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for protecting installed construction requirements.
- B. Do not install hydronic pressure gauges until after systems are pressure tested.

END OF SECTION

SECTION 233100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. Section Includes:
 - 1. Duct materials.
 - 2. Insulated acoustical flexible ducts.
 - 3. Single-wall spiral round ducts.
 - 4. Transverse duct connection system.
 - 5. Ductwork fabrication.
 - 6. Joint sealing.
 - 7. Duct cleaning.

1.2 PERFORMANCE REQUIREMENTS

- A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.3 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Product Data: Submit data for flexible duct, duct liner, duct sealants, and duct connectors.

1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for closeout procedures.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- B. Construct ductwork to NFPA 90A and NFPA 90B and NFPA 96 standards.

PART 2 PRODUCTS

2.1 DUCT MATERIALS

- A. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G60 zinc coating of in conformance with ASTM A90/A90M.
- B. Fasteners: Rivets, bolts, or sheet metal screws.
- C. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 FLEXIBLE DUCTS

- A. Manufacturer: Subject to compliance with requirements, provide flexible ductwork of one of the following:
 - 1. Atco Rubber Products.
 - 2. Flexmaster.
 - 3. Hart & Cooley.
 - 4. JP Lamborn Co.
 - 5. Thermaflex.

- B. Insulated Acoustical Medium-Pressure Flexible Duct:
1. Reference Flexible Duct: JP Lamborn Co. AMR-25.
 2. The duct shall be constructed of a CPE fabric supported by helical-wound galvanized steel. The fabric shall be mechanically fastened to the steel helix without the use of adhesives.
 3. The internal working pressure rating shall be at least as follows with a bursting pressure of at least 2-1/2 times the working pressure:
 - a. Positive: 3 inches wg
 - b. Negative: 1 inch wg
 4. The duct shall be rated for a velocity of at least 4,000 feet per minute.
 5. Suitable for operating temperature range of 0 degrees F to 200 degrees F.
 6. Acoustical performance, when tested by an independent laboratory in accordance with ASTM E477 and ADC Test Code FD 72-R1 shall be as follows:
 - a. The insertion loss (db) of a 10-foot length of straight duct at a velocity of 1,500 feet per minute, shall be at least:

Octave Band	2	3	4	5	6	7
Hz	125	250	500	1,000	2,000	4,000
6" diameter	30	37	38	42	48	>48
8" diameter	33	37	36	41	49	37
12" diameter	32	30	28	35	39	25

- b. The radiated noise reduction (db) of a 10-foot length of straight duct at a velocity of 2,500 feet per minute, shall be at least:

Octave Band	2	3	4	5	6	7
Hz	125	250	500	1,000	2,000	4,000
6" diameter	6	5	7	9	11	15
8" diameter	6	5	6	9	10	13
12" diameter	7	6	6	6	7	8

- c. The self-generated sound power levels (LW) db re 10^{-12} watt of a 10-foot length of duct at a velocity of 1,500 feet per minute, shall not exceed:

Octave Band	2	3	4	5	6	7
Hz	125	250	500	1,000	2,000	4,000
6" diameter	<43	<39	<37	<31	<26	<25
8" diameter	<37	33	<30	<23	<18	<21
12" diameter	<40	<37	<34	<31	<24	<22

7. Factory insulate the flexible duct with fiberglass insulation. The R value shall be at least 4.2 btu/hr/square foot/degree F, at a mean temperature of 75 degrees F.
8. Cover the insulation with a fire-retardant metalized vapor barrier jacket reinforced with crosshatched scrim having a permeance of not greater than 0.05 perm when tested in accordance with ASTM E96, Procedure A.

2.3 SINGLE-WALL SPIRAL ROUND DUCTS

- A. Product Description: UL 181, Class 1, round spiral lockseam duct constructed of galvanized steel.

B. Construct duct with the following minimum gauges:

Diameter	Gauge
3 inches to 14 inches	26
15 inches to 26 inches	24

C. Construct fittings with the following minimum gauges:

Diameter	Gauge
3 inches to 14 inches	24
15 inches to 26 inches	22

2.4 TRANSVERSE DUCT CONNECTION SYSTEM

- A. Product Description: SMACNA "F" rated rigidity class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.

2.5 DUCTWORK FABRICATION

- A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and as indicated on Drawings. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible (Round Duct Construction Standards), and as indicated on Drawings. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide turning vanes.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Minimum 4-inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- F. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree high efficiency-type tee connections (SD5-12).

2.6 JOINT SEALING

- A. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread, and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally, provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.
- B. Gaskets in Flanged Joints: Soft neoprene.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Refer to Section, ADMINISTRATIVE REQUIREMENTS for coordination and project conditions.
- B. Verify sizes of equipment connections before fabricating transitions.

3.2 INSTALLATION

- A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. All potential points of leakage on the ductwork shall be sealed with a water based liquid or mastic sealant.
- B. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- C. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 8 inches and smaller.
- D. Install duct hangers and supports in accordance with Section, HANGERS AND SUPPORTS FOR HVAC.
- E. Use double nuts and lock washers on threaded rod supports.
- F. Connect flexible ducts to metal ducts with draw bands.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.
- B. Connect air outlets and inlets to low-pressure ducts directly or with 5-foot-maximum length of flexible duct. Do not use flexible duct to change direction.

3.4 CLEANING

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for final cleaning.
- B. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.

END OF SECTION

SECTION 23300
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. This Section includes:
 - 1. Dampers.
 - a. Low-pressure manual dampers.
 - b. Control dampers.
 - c. Opposed blade balancing dampers are specified in Section, AIR INLETS AND OUTLETS.
 - 2. Turning vanes.
 - 3. Duct access doors.
 - 4. Flexible duct connections.
 - 5. Duct test holes.
 - 6. Duct silencers

1.2 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.
 - 1. Turning vanes.
 - 2. Flexible duct connections.
 - 3. Volume control dampers.
 - 4. Duct access doors.
 - 5. Duct silencers.
 - a. Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this Project.
 - b. Test Reports: Indicate dynamic insertion loss and noise generation values of silencers.
 - c. Field verification: Provide a statement that the contractor has inspected the existing conditions, confirming there is sufficient space to move the silencers into the attic and install them in the locations indicated. Note any areas where installation is not possible.
- C. Manufacturer's Installation Instructions.
- D. Warranty: All dampers shall have a 3-year warranty for rattling and noise.

1.3 CLOSEOUT SUBMITTALS

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for closeout procedures.
- B. Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

- A. Dampers tested, rated, and labeled in accordance with the latest UL requirements.
- B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

PART 2 PRODUCTS

2.1 DAMPERS

- A. Low Pressure Manual Dampers: Provide dampers of single blade type or multiblade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards."
- B. Control Dampers: Refer to Division 23 Section, CONTROL SYSTEMS, for control dampers; not work of this Section.
- C. Manufacturer:
 - 1. Air Balance, Inc.
 - 2. Airguide Corp.
 - 3. American Warming & Ventilating, Inc.
 - 4. Arrow Louver and Damper; Division of Arrow United Industries, Inc.
 - 5. Louvers & Dampers, Inc.
 - 6. Pottorff, Inc.
 - 7. Ruskin Mfg. Co.
 - 8. United Enertech
 - 9. Daniel Mfg.
 - 10. Cesco.
 - 11. NCA.
 - 12. Safe-Air.

2.2 TURNING VANES

- A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- C. Manufacturers:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
 - 5. Sheet Metal Connectors Inc. (SMC)

2.3 DUCT ACCESS DOORS

- A. Manufacturers:
 - 1. Air Balance Inc.
 - 2. Duro Dyne Corp.
 - 3. Flexmaster U.S.A., Inc.
 - 4. Ruskin Mfg. Co.
 - 5. Vent fabrics, Inc.
 - 6. Zurn Industries, Inc.; Air Systems Division.
 - 7. Pottorff, Inc.
 - 8. Kees, Inc.
 - 9. Cesco.
 - 10. United Enertech
 - 11. C & S.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- C. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1-inch-thick insulation with sheet metal cover.
 - 1. Less than 12 inches square, secure with sash locks.
 - 2. Up to 18 Inches Square: Furnish two hinges and two sash locks.

3. Access panels with sheet metal screw fasteners are not acceptable.

2.4 FLEXIBLE DUCT CONNECTIONS

- A. Manufacturers:
 1. American/Elgen Co.; Energy Division.
 2. Duro Dyne Corp.
 3. Flexaust (The) Co.
 4. Ventfabrics, Inc.
 5. Flexible Metal Hose, Inc.
 6. Unisource.
- B. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of Neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibration of connected equipment.

2.5 DUCT TEST HOLES

- A. Permanent Test Holes: Factory-fabricated, airtight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.

2.6 DUCT SILENCERS

- A. Silencers shall be of the size, configuration, capacity and acoustic performance as scheduled on the drawings. Silencers shall be fabricated by the same manufacturer.
- B. Silencers shall be constructed in accordance with ASHRAE and SMACNA Standards for the pressure and velocity classification specified for the air distribution system in which it is installed.
- C. Silencer assemblies, including acoustic media fill, natural cotton fiber, sealants and acoustical spacers shall have Class 1 flamespread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E84, NFPA 255 or UL 723.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Refer to Section, ADMINISTRATIVE REQUIREMENTS for coordination and project conditions.
- B. Verify ducts and equipment installations are ready for accessories.
- C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 INSTALLATION.

- A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section, HVAC DUCTS AND CASINGS for duct construction and pressure class.
- B. Access Door Sizes: Install minimum 8-inch x 8-inch size for hand access, 18-inch x 18-inch size for shoulder access, and as indicated on Drawings.
- C. Install temporary duct test holes and required for testing and balancing purposes. Cut or drill in ducts. Cap with neat patches, Neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

3.3 DEMONSTRATION

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for demonstration and training requirements.

END OF SECTION

SECTION 233600
AIR TERMINAL UNITS

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. This Section includes:
 - 1. Variable-volume terminal units

1.2 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Terminal Unit Product Data: Submit data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings indicating airflow, static pressure, heating coil capacity and NC designation. Include electrical characteristics and connection requirements. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of 1 inch to 4 inches wg.
- C. Acoustical Sound Wrap Product Data: Submit Manufacturer's original catalog cut sheets and material description for each sub-component incorporated into the system. Submit sound performance data.
- D. Manufacturer's Installation Instructions: Submit support and hanging details, and service clearances required.

1.3 CLOSEOUT SUBMITTALS

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for closeout procedures.
- B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists.

1.4 QUALITY ASSURANCE

- A. Test and rate air terminal units' performance for air pressure drop, flow performance, and acoustical performance in accordance with ARI 880 and ARI 885. Attach ARI seal to each terminal unit.

1.5 COORDINATION

- A. Refer to Section, ADMINISTRATIVE REQUIREMENTS for coordination and project conditions.
- B. Coordinate work with Section, INSTRUMENTATION AND CONTROL FOR HVAC.

PART 2 PRODUCTS

2.1 SINGLE-DUCT VARIABLE-VOLUME AIR TERMINAL UNITS

- A. Manufacturers:
 - 1. Anemostat
 - 2. Carrier
 - 3. Daikin
 - 4. Enviro-Tec
 - 5. Greenheck / Metalaire
 - 6. Krueger
 - 7. Price
 - 8. Titus
 - 9. Trane

- B. Product Description: Variable air volume terminal units for connection to central air systems, with electronic controls, and hot water heating coils.
- C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow, and minimum factory-set airflow and coil type.
- D. Basic Assembly:
 - 1. Casings: Minimum 22-gauge galvanized steel.
 - 2. Lining: Minimum 1/2-inch-thick Neoprene or vinyl-coated glass fiber insulation, 1.5 pounds per cubic foot density, meeting NFPA 90A requirements and UL 181 erosion requirements. Face lining with Mylar film.
 - 3. Provide low profile terminal units for inlet sizes 10" and up.
- E. Basic Unit:
 - 1. Configuration: Air volume damper assembly inside unit casing. Locate control components inside protective metal shroud.
 - 2. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating bearings; maximum damper leakage: 2% of design air flow at 3 inches inlet static pressure.
 - 3. Mount damper operator to position damper normally open.
- F. Hot Water Heating Coil:
 - 1. Construction: 1/2-inch copper tube mechanically expanded into aluminum plate fins, leak tested under water to 200-psig pressure, factory-installed.
- G. Controls: Provide controls compatible with temperature control system specified in other mechanical sections.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Refer to Section, ADMINISTRATIVE REQUIREMENTS for coordination and project conditions.
- B. Verify ductwork is ready for air terminal installation.

3.2 INSTALLATION

- A. Connect to ductwork in accordance with Section, HVAC DUCTS AND CASINGS.
- B. Provide minimum of 3 duct diameters of straight duct between VAV box inlet and first upstream elbow or reducer.
- C. Do not install flexible connector/duct at VAV box inlet or outlet.
- D. Install ceiling access doors or locate units above easily removable ceiling components.
- E. Support units individually from structure with neoprene isolation hangers. Do not support from adjacent ductwork.
- F. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- G. Install 1.5-inch-thick lined ductwork downstream of units unless noted otherwise. Refer to Section, HVAC INSULATION.

3.3 ADJUSTING

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for starting and adjusting requirements.

END OF SECTION

SECTION 233700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SUMMARY

- A. This specification section is copied from Phase 2 and as a result, not all items recorded here are required for Phase 4.
- B. Section Includes:
 - 1. Diffusers.
 - 2. Registers.
 - 3. Grilles.

1.2 SUBMITTALS

- A. Refer to Section, SUBMITTAL PROCEDURES for submittal procedures.
- B. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.3 CLOSEOUT SUBMITTALS

- A. Refer to Section, EXECUTION AND CLOSEOUT REQUIREMENTS for closeout procedures.
- B. Project Record Documents: Record actual locations of air outlets and inlets.

1.4 QUALITY ASSURANCE

- A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.
- B. Test and rate louver performance in accordance with AMCA 500.

PART 2 PRODUCTS

2.1 CEILING DIFFUSERS

- A. Manufacturers:
 - 1. Krueger Mfg. Co.
 - 2. Anemostat Products Division; Dymanics Corp. of America.
 - 3. Carnes Co.; Division of Wehr Corp.
 - 4. Titus Products Division; Philips Industries, Inc.
 - 5. Tuttle & Bailey; Division of Interpace Corp.
 - 6. Price Air Distribution Products.
 - 7. Greenheck / Metal-Aire.
 - 8. Nailor Industries.
 - 9. J & J.
- B. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity, and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- C. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- D. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.
- E. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on diffuser schedule.

2.2 REGISTERS AND GRILLES

- A. Manufacturers:
 - 1. Krueger Mfg. Co.
 - 2. Anemostat Products Division; Dymanics Corp. of America.
 - 3. Carnes Co.; Division of Wehr Corp.
 - 4. Titus Products Division; Philips Industries, Inc.
 - 5. Tuttle & Bailey; Division of Interpace Corp.
 - 6. Price Air Distribution Products.
 - 7. Greenheck / Metal-Aire.
 - 8. Nailor Industries.
 - 9. J & J.
- B. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity, and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- C. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.
- D. Wall and Ceiling Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall and ceiling systems, and that are specifically manufactured to fit into wall and ceiling construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of construction which will contain each type of wall register and grille.
- E. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as listed on register and grille schedule.
- F. Accessories:
 - 1. Provide manufacturer's standard opposed blade balancing damper of same material as the outlet material. Dampers shall be fully operable through the face of the outlet, and remain in its set position.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Refer to Section, ADMINISTRATIVE REQUIREMENTS for coordination and project conditions.
- B. Verify inlet and outlet locations.
- C. Verify ceiling and wall systems are ready for installation.

3.2 INSTALLATION

- A. Install diffusers to ductwork with airtight connection.
- B. Install balancing dampers on duct takeoff to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section, AIR DUCT ACCESSORIES.
- C. Paint visible portion of ductwork behind air outlets and inlets matte black.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

END OF SECTION

SECTION 260510
ELECTRICAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Refer to Section, SEISMIC AND WIND REQUIREMENTS FOR ELECTRICAL SYSTEMS for products and installation/anchorage requirements necessary for compliance with seismic criteria.

1.2 WORK INCLUDED

- A. This Section, supplemented by other Sections in this Division covers electrical work. Furnish material, labor, and equipment in accordance with these Specifications, the accompanying Drawings, and the directions of the Engineer. The work includes calibrating, adjusting, testing, documenting, and starting up the electrical system, as well as training the Owner's personnel.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Comply with NFPA 70, NEMA, and UL, latest editions, where applicable standards have been established.
- C. Plan, coordinate, and obtain approval from the ARCHITECT and OWNER for locations of equipment above ceilings, and associated access panels.
- D. Intent of Drawings: Exact conduit locations are not shown unless so indicated or specifically dimensioned.
- E. Departures from Drawings: Submit to the Engineer, in writing for review, details of any necessary proposed departures from these Contract Documents, and the reasons therefore, as soon as practicable and within 30 days after the award of the Contract. Make no such departures without the prior written approval of the Engineer.
- F. The Contractor shall be responsible for complete systems in accordance with the intent of these Contract Documents. The Contractor shall refer to all of the Drawings, Specifications, and submittals of other trades for details of equipment and construction which affect the work covered under this Section.
- G. Clearances: Coordinate the layout, fabrication, and installation of equipment and meet all applicable clearance requirements in front of and around equipment. Meet the requirements of the National Electrical Code, these Specifications, and the Authorities Having Jurisdiction. Obtain approvals and required inspections from all applicable agencies and Authorities Having Jurisdiction, including the electric utility.

1.4 CODES, PERMITS, AND REGULATIONS

- A. Do all work and install materials and equipment in accordance with the requirements of the National Electrical Code (NEC), NFPA 70, -70E, -72, -101, and Oregon Electrical Specialty Code (OESC), International Building Code (IBC) Sections 714 and 715 with Oregon Structural Specialty Code (OSSC) adoptions, Underwriters Laboratories (UL), applicable State and local laws and ordinances, and the electric utility.
- B. Conflicts, if any, that may exist among the above items, will be resolved at the discretion of the Engineer.

- C. Wherever the requirements of the Specifications or Drawings exceed those of the items above, the requirements of the Specifications or Drawings shall govern.

1.5 SUBMITTALS

A. General:

1. Provide complete submittals as specified herein and as required to completely describe the equipment and systems being provided.
2. In addition to the schedule requirements herein, the Contractor is responsible for providing submittals in a timely manner as required to meet the overall project schedule.
3. Should any item which deviates from these Specifications be included, the deviation shall be clearly indicated and explained at the time of submittal.
4. Submittals shall be complete, neat, orderly, and indexed. The Contractor shall check submittals for number of copies, adequate identification, correctness, and compliance with the Drawings and Specifications, and shall initial all copies.
5. Revise and resubmit all submittal information until favorably reviewed by the Engineer.
6. Review of submittal information by the Engineer shall not relieve the Contractor of responsibility for meeting the requirements of the Drawings and Specifications or for errors and omissions in submittals.

B. Review Costs:

1. The Owner's cost for review of submittals for the same proposed materials, equipment, or work shall be apportioned as follows:
 - a. The cost of review of the initial submittal and the first revised submittal will be borne by the Owner.
 - b. The cost to review all additional revised submittals after the first revised submittal will be charged to the Contractor. The cost of review shall include, without limitation, administrative, design, and engineering activities directly related to review of submittals.
 - c. If a submittal is approved and the Contractor elects to submit an alternate item for review for the same application, the Contractor shall be responsible for the review costs for the alternative submittal. The cost of review shall include, without limitation, administrative, design, and engineering activities directly related to review of submittals.

C. Product Submittals:

1. Product submittals shall be submitted within 45 days after the Notice to Proceed, except for the list of motor protective devices. In addition, no products shall be fabricated or shipped until the applicable submittals have been favorably reviewed by the Engineer.
2. As-built copies of product submittals shall be included in the O&M manuals.
3. Before any material is fabricated or shipped, furnish to the Engineer full details, shop drawings, dimensions, catalog cuts, schematic (elementary) diagrams, wiring diagrams, and other descriptive matter as required to fully describe the equipment specified under this Section.
4. Submittals shall show that the products furnished meet the applicable UL standards for its intended use.
5. Provide submittals as called out in Section, SEISMIC AND WIND REQUIREMENTS FOR ELECTRICAL SYSTEMS.
6. For service equipment, meter base, and other related materials, submit written approval from the serving electric utility to the Engineer.

D. Layout Submittals:

1. Not all required conduit details are shown. Conduit routing shown on the drawings are schematic in nature. The Contractor shall include in his bid price all work to design,

- document, submit, furnish, and install additional conduit and devices not explicitly shown on the Drawings, but otherwise required.
2. The Contractor shall inspect the locations of the conduit work. The Contractor shall observe conditions at the site, including any ongoing construction and Phase 1 Demolition activities, verify location of equipment and field devices, confirm location of required excavation and trenches including location and depth of pipe taps, and resolve any potential interferences. Before beginning construction, inform the Owner or Engineer of any conflicts, interferences, or missing equipment/systems which are identified to remain from Phase 1 per the Scope of Work on the Phase 2 Contract Drawings.
 3. For trenching, the Contractor shall determine the specific routes of conduits, pullbox locations, possible underground interferences, planned depth, and other related work. For conduits, the Contractor shall determine the routing, handhole/pullbox locations, terminations, and other design details, inspect for condition and suitability of any existing conduits that are to be reused, and inspect existing wiring to which a new connection is required.
 4. For rooms and other areas listed below, prepare and submit dimensioned equipment layouts, room layouts, and area plans. Prepare dimensioned detailed layouts and cross sections illustrating the proposed routing of all conduits, including spare conduits. Include number, size, type, and identification of all conduits, including underground and embedded conduits coordinated with structure, room equipment, mechanical equipment, and lighting. Show conduit transitions and penetrations, with allowances for bending radiuses and obstructions. For equipment entries, obtain field dimensions for existing equipment and shop drawings for new equipment, and account for the required points of entry. Where entering/existing ductbanks, conduit trapeze, and/or other groupings and transitions, include details which illustrate the arrangement and prove that what is intended to be installed will fit. Provide the information above for the following areas/installations:
 - a. Mechanical Rooms
 - b. Electrical Rooms
 - c. IT Rooms
 - d. Mechanical Chase from Basement to Second Floor
 5. Coordinate these submittals with other submittals to ensure that dimensional information pertaining to this specific project is used.

1.6 EQUIPMENT AND SYSTEM/PACKAGE COORDINATION

- A. Seek out vendor and equipment drawings and product data and ratings prior to developing submittals. Coordinate among sources of supply for electrical, motor control, instrumentation and controls, process equipment, mechanical equipment, and package equipment and systems.
- B. Incorporate interconnection and termination information into submittals.
- C. Incorporate physical layouts, conduit points-of-entry/exits into submittals and planning.
- D. Coordinate sizes and ratings, overcurrent protection, disconnect requirements, motor control, and other aspects of electrical feeds unique to the equipment and systems served.
- E. For package systems which require field assembly of components, seek out vendor and equipment drawings to obtain power and control wire interconnection requirements. Identify what is furnished with each component or system, what field wiring is required, including quantities and sizes, termination detail and locations, and terminal ratings (sizes, ampacity, temperatures), and routing within equipment, and/or conduit raceway requirements. Verify package assembly equipment ratings, feeder/subfeeder arrangements, overcurrent protection,

disconnect ratings are adequate to serve package assembly and are consistent with manufacturer recommendations.

1.7 OPERATION AND MAINTENANCE MANUALS

- A. Provide operation and maintenance manuals within 20 days after the start of the Functional Acceptance Test (FAT). Include the following, both hardcopies and electronic copies (on CD, SD card, flash drive, or other electronic media as required by the Owner):
 - 1. Corrected submittals as required herein.
 - 2. Record (as-built) wiring diagrams, interconnection diagrams, and equipment drawings.
 - 3. For all equipment suppliers, list of current names, addresses, and telephone numbers of those who should be contacted for service, information, and assistance.
 - 4. Record (as-built) Contract Drawings marked with red pencil to show revisions to the electrical work and the underground raceway and cable when different from the original Contract Drawings. Prepare by obtaining new, clean sets of Contract Drawings from the Engineer, and pay all costs for same.
 - 5. Test results.
- B. The O&M manuals shall include operating and maintenance information for all subsystems and components covered in this Section. The O&M information shall be in sufficient detail to allow the operation, removal, installation, adjustment, calibration, and maintenance of each component provided under this Section down to the printed circuit board level.
- C. Each set of manuals shall be assembled in one or more three-ring binders, each with a title page, table of contents, and heavy section dividers with labeled index tabs. When more than one binder is required, the binders shall be labeled "Volume 1," "Volume 2," etc. The table of contents shall encompass the entire set of O&M manuals, shall list the contents of each volume, and shall appear in each binder.

1.8 WARRANTY

- A. The work and materials covered in this Section shall be guaranteed for a period of 1 year from the date of acceptance thereof against defective materials, design, and workmanship.
- B. Warranty coverage shall include any and all costs for labor, travel, lodging, and parts.

PART 2 PRODUCTS

2.1 GENERAL

- A. Unless otherwise indicated, provide all first-quality new materials, free from any defects, and suitable for the intended use and the space provided. Provide materials that are UL listed, recognized, classified, or verified wherever standards have been established.
- B. Furnish and install all incidental items not specifically shown or specified which are required by good practice to provide the complete systems specified herein. This requirement includes installation and termination items for all field interconnection wiring, including that which terminates in equipment, and package systems.
- C. Unless noted otherwise, series-rated equipment and circuit breaker ratings are not acceptable.
- D. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
- E. Products shall be designed and fabricated to meet the applicable requirements of Section, SEISMIC AND WIND REQUIREMENTS FOR ELECTRICAL SYSTEMS. Product submittals shall confirm that project seismic requirements are satisfied.

2.2 SEISMIC REQUIREMENTS

- A. Product shall be designed and fabricated to meet the applicable requirements of Section, SEISMIC AND WIND REQUIREMENTS FOR ELECTRICAL SYSTEMS. Product submittals shall confirm that project seismic requirements are satisfied. This requirement covers the following items:
 - 1. Conduit/raceways.
 - 2. Boxes/enclosures greater than 12 inches any dimension
 - 3. Light fixtures.
 - 4. Switchboards.
 - 5. VFDs.
 - 6. Wall-mounted equipment (motor starters, disconnects, etc.)
 - 7. Control panels.
 - 8. Other items of weight 40 pounds or greater.

2.3 STANDARD PRODUCTS

- A. Unless otherwise indicated, provide materials and equipment which are products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturer's latest design that conforms to these Specifications.

2.4 SUPPLY VOLTAGE DISTORTION

- A. Electrical (60-Hz) power supplied to equipment furnished under this Section may contain up to 10% harmonic distortion in voltage. All systems and equipment covered in this Section shall operate properly under this condition of supply voltage distortion.

2.5 EQUIPMENT FINISH

- A. Unless otherwise indicated, finish for electrical equipment and enclosures shall be manufacturer's standard gray or ANSI 61 gray over a primer and rust inhibitor.

PART 3 EXECUTION

3.1 GENERAL

- A. Work shall be performed in a workmanlike manner by craftsmen skilled in the particular trade. Work shall be performed in accordance with the Drawings, Specifications, manufacturer's recommendations, and the best practice of the trade. Completed work shall present a neat and finished appearance.
- B. Coordinate electrical work with the Owner and the work of other trades to avoid conflicts, errors, delays, and unnecessary interference during construction.
- C. Plan, coordinate, and obtain approvals and inspections from all applicable agencies and Authorities Having Jurisdiction.

3.2 PROTECTION DURING CONSTRUCTION

- A. Throughout this Contract, provide protection for materials and equipment against loss or damage and from the effects of weather. Prior to installation, store items to be installed in indoor locations. Items subject to corrosion under damp conditions and items containing insulation, such as transformers, shall be stored in indoor, heated, dry locations.
- B. Following installation, protect materials, equipment, and insulation from corrosion, physical damage, and moisture. Cap conduit runs during construction with manufactured seals. Keep openings in boxes or equipment closed during construction. Provide temporary heating source for electrical equipment in damp locations or locations subject to condensation, including transformers, until construction is complete, and equipment is energized.

3.3 MATERIAL AND EQUIPMENT INSTALLATION

- A. Follow the manufacturer's installation recommendations unless otherwise indicated. Follow the Engineer's decision, at no additional cost to the Owner, wherever any conflict arises between the manufacturer's instructions, State or other codes and regulations, and these Contract Documents. Keep copy of the manufacturer's installation instructions available on the jobsite for review at all times.
- B. Install freestanding equipment in accordance with the manufacturer's recommendations. Unless noted otherwise, mount freestanding equipment on a 4-inch concrete pad. Secure freestanding equipment rigidly to floors or mounting pads with anchor bolts, expansion shields, or other approved means.
- C. Refer to Section, HANGERS AND SUPPORTS, for additional installation requirements.
- D. Seismic Requirements
 - 1. Installation of products provided under this Section shall meet the applicable requirements of Section, SEISMIC AND WIND REQUIREMENTS FOR ELECTRICAL SYSTEMS.
- E. Clearances
 - 1. Coordinate the layout, fabrication, and installation of equipment and meet all applicable clearance requirements in front of and around equipment. Meet the requirements of the National Electrical Code, these Specifications, and the Authorities Having Jurisdiction. Obtain approvals from Authorities Having Jurisdiction, including the electric utility.
- F. Accessibility
 - 1. All equipment installed shall be accessible for operation and maintenance purposes.
 - 2. 'Accessible is defined as being capable of being reached without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping, and ductwork. Access must not exceed 14 feet in height, a typical ladder working height.
- G. Unless noted otherwise, pieces of freestanding equipment located adjacent to one another shall be installed such that the fronts line up.
- H. Provide engraved nameplates for all pieces of equipment. Refer to Section, ELECTRICAL IDENTIFICATION.

3.4 PHASE 3 COORDINATION

- A. This Project consists of Phase 4 of a multi-phased approach to the remodel. See Sheet E1.0 for coordination requirements with prior phases.

3.5 CUTTING AND PATCHING

- A. Do not cut or notch any structural member or building surface without specific approval of the Engineer. Carefully carry out any cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces neatly to new condition using skilled craftsmen of the trades involved, at no additional cost to the Owner.

3.6 CLEANING AND TOUCHUP PAINTING

- A. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from the premises and from the interior and exterior of all devices and equipment. Refinish damaged surfaces to new condition using skilled craftsmen of the trades involved, at no additional cost to the Owner.

3.7 GROUNDING

- A. For grounding, refer to Section, GROUNDING AND BONDING.

3.8 LIGHTING FIXTURES

- A. Deliver lamps to the project in their original cartons. After construction of the total project is completed, wash fixtures, clean lamps, touch up any paint scratches or chips, remove labels from fixture lenses, and replace noisy ballasts.

3.9 TESTING, GENERAL

- A. Equipment testing and related test plans shall comply with applicable requirements of ANSI/NETA Acceptance Testing Specifications (ATS), latest edition. Test plans shall be developed in accordance with NETA ATS requirements, and include additional testing included in these specifications.
- B. Equipment testing shall be performed by a NETA Level 3 certified technician, minimum. A lower-level technician may assist only under the direct supervision and sight of the Level 3 or higher technician. The Contractor shall submit evidence of all testing technicians' qualifications.
- C. Testing, test plans, and test reports shall be provided by the Contractor as specified herein. The Contractor shall perform tests as required to demonstrate that the equipment and systems covered in this Section operate safely and meet the requirements of these Specifications. The Contractor shall provide labor, instruments, and other material to complete the tests.
- D. Test plans and test reports shall be submitted as formal submittals and shall meet all applicable requirements of the Article, SUBMITTALS.
- E. Tests and test plans shall be in the cause and effect format. The person conducting the test shall initiate an action (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.
- F. Tests and test plans shall be integrated across equipment and systems. The Contractor shall coordinate and integrate the documentation and efforts of suppliers and subcontractors to achieve unified tests and test plans.
- G. Initial equipment start-up shall be performed by the equipment manufacturer.

3.10 FUNCTIONAL ACCEPTANCE TEST (FAT)

- A. Once the facility has been started up and is operating, a witnessed FAT shall be performed on the equipment and systems specified under this Section to demonstrate that they are operating as specified and meet the requirements of the Specifications.
- B. The FAT shall be performed by the Contractor and may be coordinated with testing of equipment and systems covered under other Sections of these Specifications.
- C. The Contractor shall prepare a test plan for the FAT and shall submit it for review at least 30 days before the FAT is performed. As part of the test plan, the Contractor shall list the personnel who will be present to assist with and witness the FAT. This list shall include any Contractor's personnel, subcontractors, suppliers' representatives, and other necessary personnel.
- D. Each function shall be demonstrated. The FAT shall operate all equipment and systems over the full operating range, shall demonstrate proper operation of alarms and indicators, and, in general, shall demonstrate that the equipment and systems meet the requirements of the Drawings and Specifications.
- E. If any equipment or system fails the FAT, the Contractor shall correct the problem and shall repeat the test until it is successful.
- F. The FAT shall be performed in the presence of the Architect or Engineer, and the Owner.
- G. After completion of the FAT, the Contractor shall prepare a test report and shall submit it for review. The system will not be accepted before the FAT is successfully completed and the test report submitted to and favorably reviewed by the Engineer.

3.11 FINAL ADJUSTMENTS

- A. Upon completion of the FAT, final adjustments shall be made to the equipment as necessary.

3.12 FIELD SUPPORT

- A. For equipment, provide the services of an experienced, factory-trained representative of the manufacturer to attend precommissioning checkout; assist with installation, checkout, startup, and testing; and to instruct operating personnel in the operation, shutdown, startup, and maintenance of the equipment.
- B. Timing and length of site visits shall be coordinated with the Contractor, but minimum effort shall be 2 man-days on the site for installation and checkout. The service engineer or technician shall also be present during the FAT for the systems and equipment specified in this Section. This time does not include training of Owner's personnel and content of training sessions.
- C. Timing of training sessions shall be on dates and at times mutually agreeable to the Contractor and the Owner. Minimum effort for training shall be three separate classes of 4 hours each. Training sessions shall include operation, maintenance, and troubleshooting.

END OF SECTION

SECTION 260511
SEISMIC AND WIND REQUIREMENTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 WORK INCLUDED

- A. This Section covers design, installation, and anchorage of electrical and I&C equipment, enclosures, and components for seismic and wind loads.
- B. This Section covers all items listed under SEISMIC REQUIREMENTS in Section ELECTRICAL.

1.2 RELATED SECTIONS

- A. This Section covers equipment and components specified in Divisions 26, 27, and 28.

1.3 STANDARDS/REFERENCES

- A. This Section includes applicable requirements of the latest edition of the following:
 - 1. Minimum design loads for buildings and other structures (ASCE/SEI 7-16).
 - 2. 2022 Oregon Structural Specialty Code (OSSC).
 - 3. 2021 International Building Code (IBC).
 - 4. ICC Evaluations Services, Inc.

1.4 DESIGN PHILOSOPHY

- A. Seismic criteria are presented in this Section. These criteria, local/state/Federal requirements, and manufacturer requirements and recommendations shall be identified and conformed to in calculations and submittals. The most restrictive criteria shall prevail.
- B. Structural requirements apply to construction of enclosures and their contents, and anchorage of enclosures and equipment. Enclosures and their contents can either be manufactured assemblies or custom-fabricated assemblies. The Contract Documents describe and/or show enclosures and equipment, with arrangements and anchorage which are believed to generally be of the scope and scale, to meet the criteria herein. However, the details are project-specific and equipment-specific, and what is shown is not to be relied upon for construction. It is the Contractor's responsibility to design, furnish, and install equipment and systems which comply with the criteria. This includes developing and submitting evidence of compliance.
- C. Submittals pertaining to enclosures themselves, including their contents and physical construction thereof, need not include submitted calculations. The submittals are to include manufacturer and/or fabricator-written confirmation that the criteria are met.
- D. Submittals pertaining to anchorage of enclosures and equipment shall include calculations stamped by a qualified Registered Professional Engineer.

1.5 SUBMITTALS

- A. General:
 - 1. This Section hereby includes the applicable submittal requirements of Section, ELECTRICAL.
 - 2. Review of submittal information by the Engineer shall not relieve the Contractor of responsibility for meeting the requirements of the Drawings and Specifications or for errors and omissions in submittals.
 - 3. For installation (anchors, footings, supports, bracing, seismic control devices, etc.), provide calculations, details, and other data. Calculations shall be prepared and signed by a civil or structural engineer registered in the state where the project is to be constructed.

- B. Layout Submittals:
1. Perform detailed investigations of existing conditions at the site. Coordinate locations and routing, layouts, elevations, clearances, sizes, and materials of all equipment.
 2. Seek out project information including equipment dimensions, arrangements, weights, shop drawings with mounting/anchorage points, and all applicable information.
 3. Include layout and mounting detail drawings showing system and proposed brace locations for all systems including pre-engineered systems.
 4. Identify specific details for each type of brace or anchor and reference on a plan that identifies the required locations.
 - a. Submitting a book of details without referencing the proper detail to a specific location on a Drawing will not be accepted.
 5. Provide structural calculations for required lateral force level for each component.
 - a. Provide summary of loads to each component.
- C. The Contractor shall submit a statement of responsibility to the Owner acknowledging an awareness of the special inspection requirements for the Project. The statement shall specifically acknowledge that the Contractor has made provisions in the Project construction schedule to allow for completion of all special inspections.

1.6 SUMMARY OF REQUIREMENTS

- A. Contractor shall be responsible for design and installation of seismic bracing and anchorage systems.
- B. Below is a summary of requirements. Where other devices/equipment are required/specified, they too shall meet similar requirements.

Device/Equipment		Construction and Fabrication		Anchorage	
Description	Where Specified	Design Requirements	Evidence	Design Requirements	Evidence
Electrical enclosures, inside	262300, 262416	Seismic	Manufacturer Literature	Seismic	Calculations, Shop Drawings

- C. Anchorage design shall comply with Appendix D of ACI 318 (Building Code Requirements for Structural Concrete).
- D. Anchorage of equipment shall be coordinated with suppliers, trades, subcontractors such that the proposed methods are accepted, and so that the work can be accomplished within the normal progression of construction. Coordinate with the concrete subcontractor so that anchorage may be installed prior to the time of concrete placement. If calculations and anchorage details are not submitted prior to placement of concrete, the Contractor shall be responsible for any strengthening of concrete elements to resist superimposed seismic or wind loading.

1.7 SEISMIC CRITERIA

- A. Seismic Design Criteria: Provide transverse and longitudinal bracing and anchoring for structural equipment designed, constructed, and installed to resist stresses produced by lateral forces.
- B. Seismic forces shall be presumed to act through the center of mass of the equipment in the direction that will produce the largest single anchor force.
- C. Vertical seismic forces, when required, shall be presumed to act concurrently with horizontal seismic forces.
- D. Do not use friction to resist sliding due to sliding forces.

1.8 EQUIPMENT, ENCLOSURES, AND THEIR CONTENTS

- A. Commercially manufactured standard products, including enclosures and equipment, shall be designed and fabricated to meet the requirements in this Section. It is not a requirement that the standard product assemblies be re-engineered to demonstrate compliance. However, as a formal submittal(s), the manufacturers of items of weight 40 pounds or greater shall assert compliance with the requirements in this Specification.
- B. Anchorage is project-specific, and documentation demonstrating compliance shall be prepared and submitted as specified herein.

1.9 AUTHORITIES HAVING JURISDICTION

- A. In addition to the requirements herein, meet the requirements of other Authorities Having Jurisdiction, including the Fire Marshal and the city, county, and state in which the Project is located.

PART 2 PRODUCTS

2.1 EQUIPMENT ANCHORS AND SUPPORTS

- A. Cast-in-place Concrete Anchors:
 - 1. Building, Non-Building Structures, and Equipment:
 - a. ASTM F1554, Grade 36, Grade 55 or Grade 105 with weldability supplement S1 for galvanized or non-galvanized threaded rods.
 - b. ASTM A307, Grade A for galvanized headed bolts.
 - 2. All other cast-in place concrete anchors: ASTM F593, Type 316 stainless steel with matching nut and washer.
 - 3. Anchors permanently exposed to weather or corrosive environments shall be stainless steel or hot-dipped galvanized.
- B. Expansion, Epoxy, and Adhesive Concrete Anchors:
 - 1. ASTM F593 Type 316 stainless steel with matching nut and washer.
 - 2. Provide minimum edge distance, cover, and spacing as recommended by manufacturer, or as indicated on Drawings, whichever is larger.
 - a. Minimum embedment as recommended by manufacturer or 12 diameters of anchor, whichever is larger.
 - b. Notify Engineer if required depth of embedment cannot be achieved at a particular anchor location.
 - c. Follow manufacturer's recommendation for installation and torque.
 - 3. Anchors permanently exposed to weather or corrosive environments shall be stainless steel or hot-dipped galvanized.
- C. Threaded Concrete Inserts:
 - 1. This Specification shall govern and be required in lieu of all references to any other concrete insert anchors, drop-in anchors, or other generic names for threaded concrete inserts in these Project Specifications
- D. Headed Studs: ASTM A108 with minimum yield strength of 50,000 psi and a minimum tensile strength of 60,000 psi.
- E. Deformed Bar Anchors: ASTM A496 with a minimum yield strength of 70,000 psi and a minimum tensile strength of 80,000 psi.
- F. Washers:
 - 1. ASTM F436 or minimum 1/2-inch-thick fabricated ASTM A36 square plates for all cast-in-place anchorage.
 - 2. If stainless steel anchorage is being used for cast-in-place anchorage, washers shall be the same material and alloy as in the accompanying anchorage.
 - 3. Follow manufacturer's requirements for all post-installed anchorage.

- G. Nuts:
 - 1. ASTM A563 for all cast-in-place anchorage.
 - 2. If stainless steel anchorage is being used for cast-in-place anchorage, nuts shall be the same material and alloy as in the accompanying anchorage
 - 3. Follow manufacturer's requirements if using post-installed anchorage.
- H. Galvanizing Repair Paint:
 - 1. High zinc dust content paint for regalvanizing welds and abrasions.
 - 2. ASTM A780.
 - 3. Zinc content: Minimum 92% in dry film.
- I. Structural steel: ASTM A36.

PART 3 EXECUTION

3.1 WALL-MOUNTED EQUIPMENT

- A. Provide anchorage in accordance with product manufacturer's recommended installation. If manufacturer recommended installation is not available, retain a structural engineer to perform calculations and recommend anchorage.

3.2 GROUND-MOUNTED EQUIPMENT

- A. Provide anchorage in accordance with product manufacturer's recommended installation. If manufacturer recommended installation is not available, retain a structural engineer to perform calculations and recommend anchorage.

END OF SECTION

SECTION 260519
LOW-VOLTAGE CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. This Section hereby includes the applicable general requirements of Section, ELECTRICAL.
- C. Refer also to Section, ELECTRICAL IDENTIFICATION.

1.2 WORK INCLUDED

- A. This Section covers low-voltage wire and cable.

1.3 SUBMITTALS

- A. This Section hereby includes the applicable submittal requirements of Section, ELECTRICAL.
- B. Meet applicable submittal requirements of Section, SUBMITTAL PROCEDURES.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70, National Electrical Code, and UL, latest editions.
- B. Meet the applicable requirements of Section, ELECTRICAL, including the following:
 - 1. Field investigations.
 - 2. O&M manuals.
 - 3. Warranty.

PART 2 PRODUCTS

2.1 GENERAL

- A. This Section hereby includes the applicable general product requirements of Section, ELECTRICAL.

2.2 CONDUCTORS

- A. This Article covers insulated wire and cable, not buses.
- B. Conductors shall be copper, unless aluminum is indicated. Conductors, including insulation, cabling, jacket, filler, shielding, covering, and testing, shall meet applicable requirements of ANSI/NEMA WC 70-2009/ICEA S-95-658-2009, the NEC, and UL.
- C. Unless noted otherwise, conductors shall have 600-volt type THWN insulation.
- D. Metal Clad Cable (MC): Cable shall be a factory assembly of soft-drawn copper THHN/THWN phase conductors (quantity and sizes as shown on Drawings), and an insulated ground conductor housed in a flexible interlocking aluminum or steel armor. Conductors shall be UL listed and rated 90 degrees C dry, 75 degrees C wet. Connectors and fittings used on MC Cable shall be listed and identified for the cable type. MC Cable shall be Southwire Armorlite Type MC, or equal.

PART 3 EXECUTION

3.1 GENERAL

- A. This Section hereby includes the applicable general execution requirements of Section, ELECTRICAL, including the following:
 - 1. Protection during construction.

2. Equipment installation.

3.2 CONDUCTORS AND TERMINATIONS

A. General:

1. Wire shall be continuous from outlet to outlet of the raceway system. Conductors shall not be smaller than No. 12 AWG for lighting and power circuits, No. 14 AWG for control circuits, and No. 18 AWG for twisted shielded cables, unless otherwise indicated.
2. Conductors shall be stranded; except solid conductors No. 10 AWG and No. 12 AWG may be used for branch circuit power wiring and for lighting and receptacle circuits.
3. Provide adequate length pigtails for conductors connected by others.
4. Arrange wiring in enclosures and terminal junction boxes neatly cut to proper length. Apply terminals to control wiring, including spares, for connection to terminals, and bridle and secure in an approved manner. List all circuits emanating from power, distribution, and lighting panelboards by function on the directory card.
5. Identify conductors at all splices and terminations using sleeve-type wire markers permanently marked with the same wire number as shown on the submitted control schematics (elementary diagrams) and wiring diagrams.

B. Conductor Identification:

1. Reference Specification Section, ELECTRICAL IDENTIFICATION, for additional requirements.
2. Cables No. 8 AWG and smaller shall be factory color coded with a separate color for each phase and neutral. No. 6 AWG and larger may be black with colored 3/4-inch vinyl plastic tape for 6 inches at each end and at all terminations and in pullboxes.
 - a. All 120/208-volt system feeder cables and branch circuit conductors shall be color coded as follows: Phase A-black; Phase B-red; Phase C-blue; and Neutral-white.
3. General purpose 60-Hz control conductors shall be color coded violet, except neutrals shall be white.
4. General purpose dc control conductors shall be color coded blue.
5. 120V ac control conductors shall be red.
6. Conductors located in control panels which source a foreign voltage (external to the control panel) shall be yellow.
7. Insulated ground conductors, in all cases, shall be green.

C. Lacing of Wires and Cables:

1. All wires and cables shall be tagged and laced in all pullboxes, junction boxes, or similar enclosures, and at each termination. Wires and cables shall be laced so that the wires of the individual circuits are laced together by circuit, and the laced-together circuit or cable shall be tagged with the circuit number and equipment served. All wiring entering and exiting control panels shall be bundled into groups and clearly labeled as to the field destination of the wiring. Power, lighting, control, alarm, and instrumentation wiring shall be bundled, laced, and tagged, as specified herein.

D. Splices and Terminations:

1. Conductors shall be run between pieces of equipment without splices. Splices, where required, shall be made in accessible boxes only and only where indicated on the Drawings or otherwise approved by the Engineer.
2. Where Engineer-approved splices are used below grade or in wet locations, including vaults, approved splice kits shall be used. Tape splices are not allowed.
3. Soldering shall not be used, except where required by the type of device terminals.
4. Make splices and terminations of stranded conductors using crimp-type or mechanical devices suitable for the type and size of conductor used. Provide minimum 30A rated

terminal blocks for all field interconnection wiring among all equipment, products, and instruments on the project.

5. For control wiring, use pre-insulated ring-tongue crimp-type devices, except where terminals of factory-supplied equipment do not so allow. Use terminals, connectors, and installation tools as recommended by the manufacturer. Crimp-type lugs shall be applied with a tool so designed that once the crimping action is started, the tool cannot be removed until the crimping action is completed.
6. Do not use wire nuts or solder for splices or terminations; except wire nuts may be used with solid wires as indicated below.
7. For solid conductors No. 12AWG and smaller and for terminations at individual lighting fixtures, make splices and terminations using wire nuts or threaded mechanical devices suitable for the type and size of the conductor used. Wire nuts shall be the coiled, spring-loaded type. Do not use wire nuts constructed of one solid piece (not spring loaded).
8. For solid conductors No. 10AWG and larger, make splices and terminations using threaded mechanical devices suitable for the type and size of conductor used.

E. Shielded Wire and Cable:

1. Maintaining the integrity of cable shielding is essential. Shield grounding shall occur at one point, and at one point only. Take special care in cable installation to ensure that unwanted grounds do not occur because of careless terminations or damage to the jacket over the shield. Take special care to ensure that random contact of shields of adjacent cables does not occur.
2. Provide crimp-type (solderless) lugs, connectors, and ferrule-ring assemblies of the proper size for the conductor used. Crimp devices using the tool recommended by the device manufacturer. The tool shall be designed such that once the crimping action is started, the tool cannot be removed until its jaws "bottom." Leave no shields bare. Where shields have been stripped, re-insulate with shrink tubing. Where a shield branches off from a parent conductor, leave no bare wire or shield exposed. To dead end shields, strip back outer jacket and shield, and insulate shield end with shrink tubing.
3. To ground shields, strip outer jacket back and unwrap shield. Splice shield to a length of green insulated conductor or cover with shrink tubing. In either case, insulate with shrink tubing the length of conductor near where the shield branches off. As an alternate shield grounding method, use manufactured crimp-type ferrules and rings to splice a length of ground conductor to the shield. Use devices manufactured by Burndy, Amp, or equal. Device size, type, and installation procedure shall be in accordance with the device manufacturer's recommendations for the type of conductor used. Do not loop ground conductors from one shield to another. Ground each shield separately.

3.3 TESTING

- A. Meet the applicable testing requirements of Section, ELECTRICAL.
- B. Perform a detailed point-to-point wire check of interconnection wiring as specified in Section, ELECTRICAL.
- C. Perform insulation testing as specified in Section, ELECTRICAL.

3.4 AS-BUILT DOCUMENTATION

- A. Provide record (as-builts) Contract Drawings marked in red pencil to show work revisions of low-voltage conductors.

END OF SECTION

SECTION 260526
GROUNDING AND BONDING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. This Section hereby includes the applicable general requirements of Section, ELECTRICAL.

1.2 WORK INCLUDED

- A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

- A. This Section hereby includes the applicable submittal requirements of Section, ELECTRICAL.
- B. Product Data: For each type of product indicated.
- C. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in PART 3, FIELD QUALITY CONTROL Article, including the following:
 - 1. Ground rods.
 - 2. Grounding for sensitive electronic equipment.
 - 3. Structural steel
 - 4. Metal cold water pipe

1.4 QUALITY ASSURANCE

- A. Meet the applicable requirements of Section, ELECTRICAL, including the following:
 - 1. Field investigations
 - 2. O&M Manuals
 - 3. Warranty
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to Authority Having Jurisdiction, and marked for intended use.
- C. Comply with UL 467 for grounding and bonding materials and equipment.
- D. Comply with NFPA 70, latest edition.

PART 2 PRODUCTS

2.1 GENERAL

- A. This Section hereby includes the applicable general product requirements of Section, ELECTRICAL.

2.2 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600V, unless otherwise required by applicable Code or Authorities Having Jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.
 - 3. Tinned Conductors: ASTM B33.
- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 inch by 2 inches, minimum in cross section, unless otherwise indicated; with insulators.

2.3 CONNECTORS

- A. Listed and labeled by a Nationally recognized testing laboratory acceptable to Authorities Having Jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted 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. Compression Grounding Conductors:
 - 1. Compression grounding connectors shall be suitable for the intended use; shall be suitable for direct-burial and embedded applications; and shall be designed for connecting to copper and copper-clad conductors, both stranded and solid, and to copper-clad, galvanized, and stainless steel ground rods.
 - 2. Connectors shall be pre-filled with corrosion-inhibiting compound which is compatible with the conductors being joined.
 - 3. Connectors shall meet the requirements of IEEE standard 837 (latest revision), and shall meet UL standards for direct burial in earth and embedment in concrete.
 - 4. Connectors shall be selected and installed according to the recommendations of the manufacturer.
 - 5. Compression grounding connectors shall be Burndy "Hyground," or equal.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Shall be copper-clad steel, not less than 3/4 inch in diameter, a minimum 10 feet in length.

PART 3 EXECUTION

3.1 GENERAL

- A. This Section hereby includes the applicable general execution requirements of Section, ELECTRICAL, including the following:
 - 1. Protection during construction
 - 2. Equipment installation
 - 3. Seismic requirements

3.2 FIELD INVESTIGATIONS

- A. This project involves modifications to existing facilities. For each existing service, switchboard, panel, and/or item of electrical distribution open up the enclosure and investigate existing grounding arrangement.
- B. Develop and submit a grounding sketch showing each ground connection, including equipment, ground wire, and connections to grounding electrodes such as water pipes, Ufer grounds, and ground rods. Mark up the sketch with proposed ground means which comply with this Specification and the Drawings.
- C. Ground existing, modified, and new equipment and systems in accordance with this Specification and the Drawings.

3.3 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 copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches below grade.
- C. Grounding Bus: Install in electrical and communication/data equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches 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, down to specified height above floor, and connect to horizontal bus.
- D. 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: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- 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. Cable trays.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120V 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. Signal and Communication Equipment: 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.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-inch by 2-inch by 12-inch grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.5 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 Rods: Drive rods into the earth such that a minimum of 8 feet is in direct contact with the soil, as required by NEC 250-53.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods 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.
- C. 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 so vibration is not transmitted to rigidly mounted equipment.
- D. 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, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, 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. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
- E. 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.
- F. Where existing electrical systems are being modified, incorporate existing grounds/bonds into the modified system where applicable.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections, and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminals and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than 2 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.
- B. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity 500kVA to 1,000kVA: 5 ohms.
 - 3. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).

- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly, and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 260529
HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. This Section hereby includes the applicable general requirements of Section, ELECTRICAL.
- C. Refer to Section, SEISMIC AND WIND REQUIREMENTS FOR ELECTRICAL SYSTEMS for products and installation/anchorage requirements necessary for compliance with seismic criteria.

1.2 WORK INCLUDED

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit. (Also referenced as GRS: Galvanized stainless steel)

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a Professional Engineer registered in the State where the project is to be constructed, 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 five times the applied force.

1.5 SUBMITTALS

- A. This Section hereby includes the applicable submittal requirements of Section, ELECTRICAL, and other Division 26 Sections.
- B. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- C. Shop Drawings: Show fabrication and installation details, and include calculations prepared and stamped by a Civil or Structural Engineer registered in the State where the project is located for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Non-metallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.

1.6 QUALITY ASSURANCE

- A. Meet the applicable requirements of Section, ELECTRICAL, including the following:
 - 1. Field investigations.
 - 2. O&M manuals.
 - 3. Warranty.
- B. Comply with NFPA 70, National Electrical Code, and UL, latest editions where applicable standards have been established.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases with the equipment furnished under this Contract. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations specified in Division 07.

PART 2 PRODUCTS

2.1 GENERAL

- A. This Section hereby includes the applicable general product requirements of Section, ELECTRICAL.
- B. Unless otherwise indicated, provide all first-quality new materials, free from any defects, and suitable for the intended use and the space provided. Provide materials that are UL listed, recognized, classified, or verified wherever standards have been established.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. All conduit fittings, straps, hardware, and supports shall be constructed of the same material and coating as the conduit being supported. In cases where multiple conduit types are supported, the supports shall meet the more rigid requirement (e.g., use SST supports where GRS and SST conduits are supported).
- B. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers shall be Allied Tube & Conduit, Cooper B-Line, Inc., Unistrut, or equal.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Non-metallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Channel Dimensions: As shown on the Drawings, or as required for applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel 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 A36/A36M, 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. Manufacturers shall be Hilti, Inc., ITW Ramset/Red Head, Simpson Strong-Tie Co., Inc. or equal.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated 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. Manufacturers shall be Cooper B-Line, Inc., Hilti, Inc., ITW Ramset/Red Head, or equal.
 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 A325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.3 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 Division 05 for steel shapes and plates.

PART 3 EXECUTION

3.1 GENERAL

- A. This Section hereby includes applicable general execution requirements of Section, ELECTRICAL.

3.2 TESTING

- A. Coordinate testing with testing of other systems and equipment. Meet applicable requirements of Section, ELECTRICAL.

3.3 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 (GRS), or SST conduit as required by the NEC. 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.

3.4 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 (GRS), and SST conduit may be supported by openings through structure members, as permitted by the NEC.
- 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 pounds.
- 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: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or 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 Non-Structural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pullboxes 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.

3.5 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 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.

3.6 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 3,000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03.
- C. Anchor equipment to concrete base.
 - 1. Secure freestanding equipment rigidly to mounting pads with anchor bolts, expansion shields, or other approved means.
 - 2. Place and secure anchorage devices. Use supported equipment manufacturer's setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 3. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 4. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.7 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 Division 09 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 A780.

END OF SECTION

**SECTION 260533
RACEWAY AND BOXES**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. This Section hereby includes the applicable general requirements of Section, ELECTRICAL.

1.2 WORK INCLUDED

- A. This Section covers the following:
 - 1. Enclosures.
 - 2. Conduit.
 - 3. Boxes.
 - 4. Covers and device plates.

1.3 SUBMITTALS

- A. This Section hereby includes the applicable submittal requirements of Section, ELECTRICAL.
- B. Product Data: For materials and enclosures.
- C. Shop Drawings: Provide shop drawings, including plans, elevations, sections, and details.
- D. Meet applicable submittal requirements of Section, SUBMITTAL PROCEDURES.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70, National Electrical Code, NEMA, and UL, latest editions where applicable standards have been established.
- B. Meet the applicable requirements of Section, ELECTRICAL, including the following:
 - 1. Field investigations.
 - 2. O&M manuals.
 - 3. Warranty.

PART 2 PRODUCTS

2.1 GENERAL

- A. This Section hereby includes the applicable general product requirements of Section, ELECTRICAL.

2.2 ENCLOSURES

- A. Unless indicated otherwise, provide suitable NEMA-rated enclosures for all devices and equipment. Enclosures shall meet the recommendations of the device or equipment manufacturer and shall be safely and securely mounted.
- B. All pullboxes, junction boxes, and enclosures provided under this Section shall be provided with permanently mounted nameplates bearing the entire tag number of the enclosure, as identified on the Drawings. Refer to additional requirements in Section, ELECTRICAL IDENTIFICATION.

2.3 CONDUIT

- A. Galvanized Rigid Steel Conduit (GRS): Rigid metal conduit including couplings, elbows, nipples, and other fittings shall be steel galvanized after fabrication by hot-dipping, electroplating, or a metallizing process, and shall conform to the requirements of the latest editions of ANSI C80.1, NEMA FB 1, UL-6, and the NEC. Conduit bodies and covers shall be of cast malleable galvanized ferrous materials. Provide covers with gaskets.

- B. Electrical Metallic Tubing (EMT): Electrical metallic tubing, including couplings and elbows, shall conform to the requirements of the latest edition of ANSI C80.3, UL-797, and the NEC. Compression-type couplings shall be used. Do not use setscrew-type couplings, setscrew-type bushings, or setscrew-type fittings.
- C. Rigid PVC Conduit (PVC): Rigid polyvinyl chloride (PVC) conduit shall be Schedule 40, suitable for concrete-encased usage, direct-burial underground, and exposed use. Rigid PVC conduit including couplings, elbows, nipples, and other fittings shall conform to the requirements of the latest edition of NEMA TC 2 and NEMA TC 3, UL, NEC, Federal Specification WC-1094, and shall meet applicable ASTM test requirements for the intended use. PVC conduit shall be rated 90 degrees C.
- D. Flexible Conduit (Flex): Flexible conduit shall be black, UV resistant, moistureproof flexible galvanized steel, polyvinyl chloride jacketed, and shall be Anaconda Sealtite conduit, Electri-Flex, or equal. Flexible conduit used in dry, concealed areas for lighting fixtures may be non-moistureproof flexible steel conduit, Anaconda Type CN, Triangle Tristeel, or equal.

2.4 RACEWAY TAGS

- A. Provide an embossed tag on all raceways.
- B. Refer to Section, ELECTRICAL IDENTIFICATION, for raceway identification requirements.

2.5 BOXES

- A. General:
 - 1. Boxes shall not be smaller than required to meet the minimum requirements of the National Electrical Code (NEC).
- B. Sheet Steel Boxes, Small:
 - 1. These boxes shall include sizes up to 4-11/16 inches square and ganged switch boxes.
 - 2. Sheet steel boxes shall be zinc- or cadmium-plated, and shall be of the one-piece stamped or drawn type, or welded, except when not available in the size required.
 - 3. Provide boxes of adequate size without using box extensions. Boxes shall have a minimum depth of 2 inches, except where shallower boxes are required by structural conditions and where specifically approved by the Engineer. Switch and receptacle boxes shall be 2 inches wide by 4 inches high, minimum size. Other boxes shall be 4 inches wide by 4 inches high, minimum size.
 - 4. Provide covers and device plates as called out in Part, EXECUTION, Article, RACEWAY SYSTEM, Table 1 – Conduit and Box Applications.
 - 5. Small sheet steel boxes shall be Appleton OB/SB Series, Steel City, Bowers, or equal.
- C. Sheet Steel Boxes, Large:
 - 1. Boxes shall be 16-gauge sheet steel, minimum, with welded seams.
 - 2. Boxes shall be NEMA 12, minimum, in dry locations and NEMA 3R, minimum, in damp and wet locations.
 - 3. Unless shown otherwise on the Drawings, provide hinged covers on boxes with length or width greater than 12 inches. Smaller NEMA 12 boxes may have screw covers. Hinges shall be full length, with stainless steel hinge pins. Hinged covers shall have secure closing provisions. Provide draw-pull catches (two minimum), three-point latch with a single handle, or clamps on three sides to clamp the cover.
 - 4. Finish shall be ANSI 61 gray over a primer and rust inhibitor.
 - 5. Boxes shall be Hoffman, Tanco, Keystone, Electromate, or equal.
- D. Cast Boxes:
 - 1. Cast boxes shall be galvanized malleable ferrous metal, gasketed and watertight, with threaded conduit hubs and mounting lugs. Boxes shall have a minimum (inside) depth of 2 inches.

2. Provide stamped steel covers with gaskets and stainless steel or galvanized steel screws; except provide weatherproof cast covers for switches and receptacles outdoors and in wet or damp locations.
3. Cast boxes shall be Crouse Hinds FD, Appleton FD, or equal.

2.6 COVERS AND DEVICE PLATES

- A. Plastic device plates shall be of one-piece ivory nylon or phenolic, with smooth exterior faces, and shall have metal screws with oval heads and color matching that of the plate. Plastic device plates shall be Hubbell phenolic plates, Leviton plastic plates, or equal.
- B. Stainless steel device plates shall be stamped, one-piece, satin finish with matching screws with oval heads. Stainless steel metal device plates shall be Hubbell S-Series, Leviton 84000 Series, or equal.
- C. Stamped steel covers and device plates shall be one-piece and shall fit closely and tightly to the box on which they are installed. Covers shall be zinc- or cadmium-plated, with galvanized or stainless-steel screws, and shall have gaskets in wet and damp locations. On surface-mounted boxes, device plates shall be raised with rounded edges and shall not extend beyond the sides of the box.
- D. Cast covers and plates shall be galvanized malleable ferrous metal with gaskets and stainless steel screws; except cast receptacle plates shall be die-cast, copper-free aluminum.
 1. Cast switch plates in wet and damp locations shall have integral external operators for each switch. Plates shall be Crouse Hinds "Feraloy" DS Series, Appleton malleable iron FS Series, or equal.
 2. Cast receptacle plates in wet and damp locations shall have spring-loaded, gasketed, weatherproof covers for each receptacle. These plates shall be weatherproof when in use (with attachment plug cap inserted), as described in NEC 406.9.B. Plates shall be Thomas & Betts Red Dot Code Keeper, Carlon Weatherproof, Appleton Weatherproof, or equal.
- E. Box Identification:
 1. Provide an engraved nameplate on all boxes and enclosures.
 2. Refer to Section, ELECTRICAL IDENTIFICATION, for additional box/enclosure identification requirements.

2.7 OVERFLOOR RACEWAYS

- A. Where installed in walkways, raceways shall be tapered to meet ADA accessibility guidelines.
- B. Raceways shall include four separate channels supporting installation and separation of power, data, and A/V system conductors in a single raceway.
- C. Raceways shall be steel, with black powder coat finish.
- D. Raceway system shall be tamper resistant.
- E. Provide fittings and accessories to suit each installation location, including grounding clips, elbows, raceway transitions, in-wall entrance end fittings, etc.
- F. Raceway system shall be continuous for a clean, finished appearance. Install raceway up wall to accessible ceiling above with manufacturer corner fittings where transitioning from floor to wall routing.
- G. Overfloor raceways shall be Legrand Wiremold OFR series or equal.
- H. Provide all components necessary for a complete raceway system from wall to desk systems. Coordinate surface raceway layout/locations with the Owner, Architect, and furniture vendor prior to ordering equipment.

PART 3 EXECUTION

3.1 GENERAL

- A. This Section hereby includes the applicable general execution requirements of Section, ELECTRICAL, including the following:
1. Protection during construction.
 2. Equipment installation.

3.2 RACEWAY SYSTEM

- A. General: Unless otherwise specified or indicated, wiring shall consist of insulated conductors installed in raceways of the types indicated.
- B. Table 1 identifies the types of conduit and boxes to be used in various locations.

TABLE 1 – CONDUIT AND BOX APPLICATIONS				
Line No.	Location	Conduit (Notes 2, 3)	Small Boxes (Up to 4-11/16 + Ganged Switch Boxes)	Large Boxes and Terminal Junction Boxes (TJB's)
1	Indoor dry locations with concealed conduit:			
1.1	In block walls and poured concrete walls	PVC	Sheet steel	NEMA 12 sheet steel
1.2	In sheetrock walls and ceilings	EMT	Sheet steel	NEMA 12 sheet steel
2	Indoor dry locations with exposed conduit:			
2.1	Up to 10 feet above floor	GRS (Note 4)	Cast	NEMA 12 sheet steel
2.2	Above 10 feet above floor	EMT	Sheet steel	NEMA 12 sheet steel
2.4	Concealed interior locations (sheetrock walls, above ceilings). Not to be used for homeruns	MC	Sheet steel	NEMA 12 sheet steel
3	Wet and damp locations	GRS	Cast	NEMA 3R
Notes for Table 1:				
1.	Use rigid polyvinyl chloride (PVC) conduit for buried and embedded conduit; except use tape-wrapped galvanized rigid steel (GRS) through expansion joints, for at least 5 feet on both sides of the ends of ductbanks, of penetrations through footings and outside walls, for all buried and embedded 90-degree bends (ells), under equipment mounting pads, where embedded in exterior light pole foundations, and where conduit changes from underground to exposed or from embedded to exposed.			
2.	EMT may be used in place of PVC in dry, concealed locations, and GRS may be used as a substitute for EMT or PVC in any location.			

TABLE 1 – CONDUIT AND BOX APPLICATIONS				
Line No.	Location	Conduit (Notes 2, 3)	Small Boxes (Up to 4-11/16 + Ganged Switch Boxes)	Large Boxes and Terminal Junction Boxes (TJB's)
3.	Use liquidtight flexible metal conduit (flex) for the last 18 to 36 inches of conduit run to a piece of equipment where required to isolate vibration or to facilitate maintenance or adjustment. Flexible metal conduit (non-moistureproof) may be used in dry, concealed areas for lighting fixtures.			
4.	EMT may be used in dry locations where dropping from above to electrical equipment more than 6 feet above the floor.			

- C. Minimum size conduit shall be 3/4-inch, unless indicated otherwise on the Drawings.
- D. Use stamped steel covers and device plates in dry locations, and use cast weatherproof covers and device plates with gaskets in wet and damp locations; except use plastic covers and device plates in dry, finished areas.
- E. Boxes:
 - 1. Provide each outlet in the wiring or raceway systems with a box to suit the conditions encountered. Each box shall have sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of the NEC. Provide flush or recessed fixtures with separate junction boxes when required by the fixture terminal temperature requirements. Boxes used with concealed conduits shall be flush mounted, unless otherwise indicated on the Drawings.
 - 2. Install boxes in a rigid and satisfactory manner, and support boxes independently of the conduit. For frame construction, use bar hangers; on concrete or brick, fasten directly to the surface using bolts or expansion shields; and on steelwork, use machine screws. Threaded studs driven in by a powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields. Set flush-mounted sheet steel boxes flush with the finished surface. Boxes shall be of adequate size without box extensions, but provide suitable extension rings or plaster covers as required. Mounting hardware in industrial areas shall be galvanized.
 - 3. Provide terminal junction boxes as specified, where shown on the Drawings, and where otherwise needed.
- F. Installation:
 - 1. Conduit system installation shall meet or exceed the requirements of the NEC. Raceways shall be concealed or exposed, as indicated, and shall be at least 6 inches away from parallel runs of flues and steam or hot water pipes. Group raceways in same area together. Raceways shall be supported at intervals required by the NEC and shall have exposed runs installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Do not install crushed or deformed raceways. Avoid traps in raceways where possible. Take care to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Raceways shall be entirely free of obstructions or shall be replaced. All conduit shall be reamed, deburred, and cleaned for proper introduction of wires and cables. Immediately after installation, plug or cap all conduit ends with watertight and dust tight conduit seals until the time for pulling wires. In block walls, do not run conduit in the same horizontal course with reinforcing steel.

2. Avoid field-made bends and offsets where possible, but where necessary make with an approved hickey or conduit bending machine. Heating of conduit to facilitate bending shall not be acceptable, except as noted hereinafter. Changes in direction of runs shall be made with symmetrical bends or cast metal fittings. The total sum of all bends and offsets in a continuous run shall not exceed 270 degrees. In addition, for conduit runs greater than 100 feet, all bends and offsets shall not exceed 180 degrees.
3. All electrical boxes and conduit bodies in the raceway system shall be easily accessible (by a maximum 8-foot ladder), or as otherwise approved by the Engineer.
4. Install insulated bushings on the ends of all conduits, except where conduits terminate in threaded hubs on cast boxes or cabinets. Threadless fittings for electrical metallic tubing shall be of the type approved for the conditions encountered. Use insulating throat connectors where tubing terminates in boxes or cabinets. Where conduits terminate in sheet metal boxes, enclosures, or devices, use Myers watertight hubs. Provide suitable expansion fittings for raceways crossing expansion joints in structures or concrete slabs, or provide other suitable means to compensate for expansion and contraction.
5. Wooden plugs inserted in concrete or masonry are not acceptable as a base for raceway fastenings, nor shall raceways or pipe straps be welded to steel structures. Support multiple raceways adjacent to each other by ceiling trapeze. Support individual raceways by wall brackets, strap hangers, or ceiling trapeze fastened by toggle bolts or expansion shields on hollow masonry units, expansion shields on concrete or brick, and clamp-type fasteners approved for the type of installation on steelwork. Threaded studs driven in by a powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields. Use plastic-coated fasteners and supports in plastic-coated conduit systems.
6. Conduit shall be of the greatest practicable single length between joints. Joints shall be made up with approved jointing compound. Do not use red lead as a joint compound. Do not use nails to fasten conduit. Do not use wire in lieu of straps or hangers, and do not notch structural members for the passage of raceways except with prior approval of the Engineer.
7. Install and equip conduit, boxes, and fittings installed outdoors or in other wet locations so as to prevent water from entering the conduit. Do not install horizontal conduit runs through equipment foundation pads.
8. Provide a seal inside each conduit or raceway entering buildings and structures, and in raceways entering boxes and enclosures in wet locations. Seal inside the conduit with duct seal, putty, or suitable plastic expansible compound to prevent passage of rodents, gasses, and liquids. Duct seal shall be as manufactured Q-Pak, Rainbow, or equal.
9. Empty conduits shall be identified at both ends and shall be capped and provided with a copper pull wire, No. 14 AWG minimum, or 1/8-inch-minimum non-nylon cord, unless noted otherwise.
10. For PVC conduit, use factory-made ells where applicable. Use approved heating methods for forming all other bends. Provide expansion joints as required by the NEC and as recommended by the manufacturer. When joining PVC conduit to metallic fittings, use approved PVC terminal adapters. When joining PVC conduit to rigid steel conduit, use an approved PVC female adapter. PVC conduit joints shall be solvent-welded with solvent recommended by the conduit manufacturer.
11. Use strap wrenches for installing PVC-coated GRS conduit. Chain or pipe wrenches are not permitted. For field threading PVC-coated GRS, use only approved dies and conduit-holding devices. Touch up any damaged coating with manufacturer-approved coating compound.

12. Concealed, embedded, and buried conduits shall emerge at right angles and shall have none of the curved portion of a bend exposed, unless otherwise approved by the Engineer. Embedded and underground ells shall be galvanized rigid steel conduit.
13. For conduits 1-1/4 inch and larger, use mogul-type conduit bodies.
14. Where conduit size is 4 inches or less, final connection to motors, motor heaters, wall- or ceiling-mounted fans and unit heaters, dry transformers, and to other equipment where flexible connection is desired or required to minimize vibration or to facilitate maintenance or removal of equipment, shall be made with flexible conduit. Length shall be 18 inches to 36 inches, unless otherwise approved by the Engineer.
15. Flexible conduit shall not be used as a ground. Where flexible conduit is used, a separate grounding conductor shall be run with the conductors. Flexible conduit shall be secured with conduit clamps or equivalent means except where the flexible conduit is fished and where sections less than 4 feet in length are used in concealed areas for lighting fixtures.
16. In all circumstances, water shall be prevented from entering any electrical device including, but not limited to, solenoids, local control stations, enclosures, motors, VFD's, and switchgear. Conduit routing shall include low points provided with a threaded electrical drain fitting, prior to entering electrical device/ enclosure/etc.

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Penetrations may be cast in place or run through blockouts or holes, except where waterproof penetrations are required. Dry pack with non-shrink grout around conduits run through blockouts or holes.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular-sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 1. For sleeve cross-section rectangle perimeter less than 50 inches (1,270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1,270 mm) and one or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves, and seal with firestop materials.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using 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.

3.4 SLEEVE-SEAL INSTALLATION

- A. Where a waterproof penetration through a concrete structure is shown on the Drawings or called out elsewhere in the Specifications, an approved watertight conduit sealing device shall be provided.
- B. Install to seal underground, exterior wall penetrations.
- C. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

END OF SECTION

SECTION 260553
ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. This Section hereby includes the applicable general requirements of Section, ELECTRICAL.

1.2 WORK INCLUDED

- A. Section Includes:
 - 1. Identification for raceways, metal-clad cables, and control cables.
 - 2. Identification for conductors.
 - 3. Floor marking tape.
 - 4. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification labels.
 - 7. Cable ties.
 - 8. Miscellaneous identification products.

1.3 SUBMITTALS

- A. This Section hereby includes the applicable submittal requirements of Section, ELECTRICAL.
- B. Product Data: For each identification product indicated.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- D. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Meet the applicable requirements of Section, ELECTRICAL, including the following:
 - 1. Field Investigations.
 - 2. O&M manuals.
 - 3. Warranty.
- B. Comply with ANSI A13.1.
- C. Comply with NFPA 70, National Electrical Code.
- D. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- E. Comply with ANSI Z535.4 for safety signs and labels.
- F. Labeling is to be reviewed and approved by the FMP Electrical Supervisor.
- G. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, shop drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.1 GENERAL

- A. This Section hereby includes the applicable general product requirements of Section, ELECTRICAL.
- B. Unless otherwise indicated, provide all first-quality new materials, free from any defects, and suitable for the intended use and the space provided. Provide materials that are UL listed, recognized, classified, or verified wherever standards have been established.

2.2 RACEWAY, METAL-CLAD CABLE, AND CONTROL CABLE IDENTIFICATION

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage.
- C. Metal Tags: Stainless steel or aluminum, 2 inches by 2 inches by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener or stainless-steel wire.
- D. Snap-Around Labels for Raceways Carrying Circuits at 600V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches wide.
- B. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating. Label shall have black text on white printing area and clear "tail" that self-laminates the printed area when wrapped around the cable.

2.4 FLOOR MARKING TAPE

- A. 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.5 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
 - 1. Preprinted aluminum signs punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal size, 7 inches by 10 inches.

- D. Metal-Backed, Butyrate Warning Signs:
 - 1. Weather-resistant, non-fading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal size, 10 inches by 14 inches.
- E. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES [LIST SOURCES]."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.6 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 square inches and 3/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment on equipment.

2.7 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.8 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 degrees Fahrenheit, according to ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 degrees Fahrenheit to plus 185 degrees Fahrenheit.
 - 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 degrees Fahrenheit, According to ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 degrees Fahrenheit.
 - 4. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select 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 GENERAL

3.1 INSTALLATION

- A. This Section hereby includes the applicable general execution requirements of Section, ELECTRICAL.
- B. Verify identity of each item before installing identification products.
- C. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- D. Apply identification devices to surfaces that require finish after completing finish work.

- E. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- F. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands 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.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Cable Ties: For attaching tags.
 - 1. Indoors/Outdoors: UV-stabilized nylon.

3.2 SYSTEMS REQUIRING IDENTIFICATION

- A. Accessible Raceways and Metal-Clad Cables, 600V or Less: Identify with labels at 30-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pullbox of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Power.
 - 2. Data.
- C. Conductor Identification:
 - 1. Reference Section, LOW-VOLTAGE CONDUCTORS AND CABLES for additional requirements.
 - 2. Provide a complete Contractor-developed conductor identification system so that after installation, circuits can be easily traced from origin to final destination. The Contractor shall submit a proposed identification system format tailored to match existing system(s) in use and the Owner's preferences. The Owner will mark up the sample, and the resulting format shall be carried throughout the project.
 - 3. Identify conductors at all splices and terminations using sleeve-type wire markers permanently marked with the same wire number as shown on the submitted control schematics (elementary diagrams) and wiring diagrams.
 - 4. Identify conductors and multiconductor cables in all enclosure, including pullboxes, vaults, handholes, and manholes using machine-printed self-adhesive labels. The labels shall wrap entirely around the conductor or cable. Handwritten labels are not acceptable.
 - 5. Color coding and phasing shall be consistent throughout the site. Bus bars at panelboards, switchboards, and motor control centers shall be arranged phase A-B-C, top to bottom or left to right, facing the connecting lugs.
 - 6. Existing conductors which are being modified or unterminated/reterminated shall include color coding identification as indicated above.
 - 7. Install instructional signs, including the color code for grounded and ungrounded conductors using adhesive-film-type labels.
 - 8. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - a. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - b. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - c. Coordinate identification with the Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

- D. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power, Control, and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
- F. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- G. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. 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.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters as appropriate for viewing from the floor.
 - d. Fasten labels with appropriate mechanical fasteners that do not change the NEMA rating of the enclosure.
 - 2. Equipment to Be Labeled (including, but not limited to the following):
 - a. Panelboards
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchboards.
 - e. Enclosed switches.
 - f. Enclosed circuit breakers.
 - g. Enclosed controllers.
 - h. Variable-speed controllers.
 - i. Contactors.
 - j. Remote-controlled switches, dimmer modules, and control devices.
 - k. Battery-inverter units.

END OF SECTION

SECTION 262416
PANELBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. This Section hereby includes the applicable general requirements of Section, ELECTRICAL.

1.2 WORK INCLUDED

- A. This Section covers lighting and power distribution panelboards, complete.
- B. The Contractor shall furnish and install the panelboards as specified and shown on the Contract Drawings.

1.3 SUBMITTALS

- A. This Section hereby includes the applicable submittal requirements of Section, ELECTRICAL.
- B. The following information shall be submitted to the Engineer:
 - 1. Breaker layout with sizes.
 - 2. Component list.
 - 3. Conduit entry/exit locations.
 - 4. Mounting.
 - 5. Assembly ratings including:
 - a. Short-circuit
 - b. Voltage
 - c. Continuous current
 - 6. Cable terminal sizes.
 - 7. Product datasheets.
 - 8. NEMA rating.
- C. The following information shall be submitted following installation for inclusion in project O&M Manuals:
 - 1. Final as-built drawings and information incorporating changes made during the manufacturing process.
 - 2. Installation information.
 - 3. Seismic certification and equipment anchorage details as specified.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70, National Electrical Code, latest edition.
- B. Meet the applicable requirements of Section, ELECTRICAL.
- C. The panelboards and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA and UL, including:
 - 1. UL 67 – Panelboards
 - 2. UL 50 – Cabinets and boxes
 - 3. NEMA PB1
 - 4. Federal Specification W-P-115C
- D. Panelboard overcurrent protective devices shall be selectively coordinated with all supply side overcurrent protective devices as required by NFPA 70, Articles 645.27, 700.27, 701.27, and 708.54.
- E. The panelboards shall be UL labeled.

PART 2 PRODUCTS

2.1 GENERAL

- A. This Section hereby includes the applicable general product requirements of Section, ELECTRICAL.
- B. Unless otherwise indicated, provide all first-quality new materials, free from any defects, and suitable for the intended use and the space provided. Provide materials that are UL listed, recognized, classified, or verified wherever standards have been established.
- C. This Section hereby includes the applicable product requirements of Section, ELECTRICAL.

2.2 PANELBOARDS

- A. Lighting and power panelboards shall be circuit breaker type with fully rated short-circuit equipment ratings. Series short-circuit equipment ratings are not acceptable. Circuit breakers shall be of the indicating type, providing ON, OFF, and TRIPPED positions of the operating handle.
- B. Panelboard assemblies shall be UL listed and labeled.
- C. Panelboard interiors shall be completely factory assembled and designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
- D. Trims for panelboards shall be supplied with a hinged door covering all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi-flush cylinder lock and catch assembly. Where panelboard locks are installed, all panelboard locks shall be keyed alike.
- E. Main bus bars shall be copper or tin-plated copper sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.
- F. A system ground bus shall be included in all panels.
- G. Full-size (100%-rated) insulated stand-off neutral bars shall be included for panelboards shown with neutral. Neutral busing shall have a suitable lug for each downstream circuit requiring a neutral connection.
- H. A typed directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.
- I. See Section, CIRCUIT BREAKERS, and drawings for circuit breaker requirements.
- J. Panelboard ratings, including voltage, interrupting (short-circuit) rating, main circuit breaker rating, branch circuit breaker ratings, enclosure and NEMA rating, and installation environment shall be as shown on the Drawings.

2.3 ENCLOSURE

- A. Enclosures shall be at least 20 inches wide made from galvanized steel. Provide minimum gutter space in accordance with the National Electrical Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.

2.4 NAMEPLATES

- A. Provide an engraved nameplate for each panelboard. Refer to Section, ELECTRICAL IDENTIFICATION for labeling requirements.

2.5 FINISH

- A. Surfaces of the trim assembly shall be properly cleaned, primed, and a finish coat of gray ANSI 61 paint applied.

PART 3 EXECUTION

3.1 GENERAL

- A. This Section hereby includes the applicable general execution requirements of Section, ELECTRICAL.

3.2 INSTALLATION

- A. Install all equipment per the manufacturer's recommendations and the Drawings.

3.3 TESTING

- A. Perform standard factory testing in accordance with the latest version of applicable NEMA, NETA-ATS, and UL Standards.
- B. Coordinate testing with testing of other systems and equipment. Meet applicable requirements of Section, ELECTRICAL.

END OF SECTION

**SECTION 262726
WIRING DEVICES**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. This Section hereby includes the applicable general requirements of Section, ELECTRICAL.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Pendant cord-connector devices.
 - 3. Cord and plug sets.
 - 4. Snap switches and wall-box dimmers.
 - 5. Lighting automated controls.
 - 6. Communications outlets.
 - 7. Wall-switch and exterior occupancy sensors.
 - 8. Wall-box motion sensors.
 - 9. Digital Lighting Management system.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. This Section hereby includes the applicable submittal requirements of Section, ELECTRICAL.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Meet the applicable requirements of Section, ELECTRICAL.
- B. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- C. 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.
- D. Comply with NFPA 70, National Electrical Code.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 PRODUCTS

2.1 GENERAL

- A. This Section hereby includes the applicable general product requirements of Section, ELECTRICAL.
- B. Unless otherwise indicated, provide all first-quality new materials, free from any defects, and suitable for the intended use and the space provided. Provide materials that are UL listed, recognized, classified, or verified wherever standards have been established.
- C. Refer to Section, ELECTRICAL, for general requirements on the following:
 - 1. Standard products

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125V, 20A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Manufacturers, or equal
 - a. Leviton Mfg. Company, Inc., Model 5801 (single)
 - b. Leviton Mfg. Company, Inc., Model BR20 (duplex)
 - 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.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125V, 20A:
 - 1. Manufacturers, or equal:
 - a. Cooper Wiring Devices, Model SGF20F.
 - b. Pass & Seymour/Legrand, Model 2084.

2.4 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity, plus a minimum of 30%.
 - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.5 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277V, 20A:
 - 1. Manufacturers, or equal:
 - a. Cooper Wiring Devices:
 - i. Model 2221 (single pole)
 - ii. Model 2222 (two pole)
 - iii. Model 2223 (three way)
 - iv. Model 2224 (four way)
 - b. Hubbell Incorporated:
 - i. Model CS1221 (single pole)
 - ii. Model CS1222 (two pole)

- iii. Model CS1223 (three way)
 - iv. Model CS1224 (four way)
 - c. Leviton Mfg. Company, Inc.:
 - i. Model 1221-2 (single pole)
 - ii. Model 1222-2 (two pole)
 - iii. Model 1223-2 (three way)
 - iv. Model 1224-2 (four way)
 - d. Pass & Seymour/Legrand:
 - i. Model 20AC1 (single pole)
 - ii. Model 20AC2 (two pole)
 - iii. Model 20AC3 (three way)
 - iv. Model 20AC4 (four way)

2.6 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider with single-pole or three-way switching. Comply with UL 1472.

2.7 LIGHTING AUTOMATED CONTROLS

- A. Refer to Drawings for requirements for lighting automated controls.

2.8 COMMUNICATIONS OUTLETS

- A. Data Outlet
 - 1. Manufacturers, or equal:
 - a. Cooper Wiring Devices.
 - b. Leviton Mfg. Company, Inc.
 - 2. Description: Two, four, and six RJ-45 jacks for 100-ohm, balanced, four-pair UTP; TIA/EIA-56B-B.1, complying with Category 6. Comply with UL 1863.

2.9 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting
Smooth, high-impact thermoplastic (0.035-inch-) thick
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum thermoplastic with lockable cover.

2.10 MULTI-OUTLET ASSEMBLIES

- A. Manufacturers, or equal:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Wiremold Company (The).
- B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- C. Raceway Material: Metal, with manufacturer's standard finish.
- D. Wire: No. 12 AWG.

2.11 FINISHES

- A. Color: Wiring device catalog numbers in Section text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 EXECUTION

3.1 GENERAL

- A. This Section hereby includes the applicable general execution requirements of Section, ELECTRICAL.

3.2 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to ensure that devices and their boxes are protected. 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 the 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 just 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 all devices that have been in temporary use during construction or that show signs that they 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 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-quarters of the way around terminal screw.
 - 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 - 7. When conductors larger than No. 12 AWG are installed on 15A or 20A 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 right.
- 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. Dimmers:
1. Install dimmers within terms of their listing.
 2. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.3 IDENTIFICATION

- A. Comply with Section, ELECTRICAL IDENTIFICATION.
1. Receptacles: Permanently identify panelboard and circuit number from which served. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

- A. Coordinate testing with testing of other systems and equipment. Meet applicable requirements of Section, ELECTRICAL.
- B. Perform tests and inspections, and prepare test reports.
1. Test Instruments: Use instruments that comply with UL 1436.
 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- C. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105V to 132V.
 2. Percent Voltage Drop under 15A Load: A value of 5% or higher is not acceptable.
 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. The 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.

END OF SECTION

SECTION 262816
CIRCUIT BREAKERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. This Section hereby includes the applicable general requirements of Section, ELECTRICAL,

1.2 WORK INCLUDED

- A. This Section covers low-voltage circuit breakers.

1.3 SUBMITTALS

- A. This Section hereby includes the applicable submittal requirements of Section, ELECTRICAL.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70, National Electrical Code and UL, latest editions, where applicable standards have been established.
- B. This Section hereby includes the applicable general requirements of Section, ELECTRICAL.

PART 2 PRODUCTS

2.1 GENERAL

- A. This Section hereby includes the applicable general product requirements of Section, ELECTRICAL.

2.2 CIRCUIT BREAKERS

- A. Circuit breakers shall be of the indicating type providing ON, TRIPPED, and OFF positions of the operating handle. Include provisions for padlocking circuit breakers in the OFF position (except in panelboards). Interlock enclosures to prevent opening the cover with the circuit breaker in the ON position, and provide defeater mechanisms. Circuit breakers shall be quick-make, quick-break, with thermal-magnetic action (except for magnetic-only trip breakers in motor starters). An overload of one pole of all multiple-pole circuit breakers shall automatically cause all poles to open. Circuit breakers shall meet the requirements of UL 489 and NEMA AB 1. Unless noted otherwise, interrupting rating shall be not less than 10,000 amps rms symmetrical. Where they are used as service entrance equipment, circuit breakers shall meet UL standards for that use.
- B. Circuit breakers used as switches shall be suitable for the application. When used as switches in 120-volt lighting circuits, they shall be listed and shall be marked SWD or HID, as required by NEC Article 240-83(D).
- C. Breakers with solid-state trip units shall have trip units of the true RMS sensing type. The electronic trip units shall have adjustable long-time, short-time, instantaneous, and ground fault trips. Breakers with solid-state trips shall be Eaton, General Electric, Westinghouse, Square D, or equal.
- D. For circuit breakers with programmable trip points, provide complete documentation, including operating instructions and setpoints and ranges, and a hand-held programmer (if available). Documentation shall be adequate to instruct an electrician on the use of the programmer to check and set trip points and ranges on the breaker. Documentation and trip points and ranges shall be provided as part of the formal submittal on the circuit breaker, and as-built at project conclusion.

- E. The use of tandem or dual-circuit breakers in a normal single-pole space to provide the number of poles or spaces specified is not acceptable.
- F. GFCI (ground fault circuit interrupter) breakers shall trip in approximately 0.025 second with a ground fault of 5mA.

PART 3 EXECUTION

3.1 GENERAL

- A. This Section hereby includes the applicable general execution requirements of Section, ELECTRICAL.

3.2 TESTING

- A. Provide testing and test reports as listed below and as required elsewhere in this Section.
 - 1. Products specified in this Section shall be completely assembled, wired, adjusted, and tested at the factory. All tests shall be in accordance with the latest version of UL and NEMA standards. After assembly, the complete switchboard will be tested for operation under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2,200 volts for 1 minute between live parts and ground, and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1,500 volts for 1 minute between live parts and ground. (Note: The SPD shall be disconnected during this test.)
 - 2. The manufacturer shall provide three certified copies of factory test reports.
 - 3. A certified test report of all standard production tests shall be available to the Engineer upon request.
- B. Provide Unwitnessed Factory Test (UFT) for the items specified in this Section.
- C. Meet the applicable testing requirements of Section, ELECTRICAL.

END OF SECTION

SECTION 262817
DISCONNECT SWITCHES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. This Section hereby includes the applicable general requirements of Section, ELECTRICAL.

1.2 WORK INCLUDED

- A. This Section covers low-voltage fused and non-fused switches as specified herein and as shown on the Drawings.

1.3 SUBMITTALS

- A. The following information shall be submitted to the Engineer:
 - 1. Dimensioned Outline Drawing.
 - 2. NEMA rating.
 - 3. Conduit entry/exit locations.
 - 4. Switch ratings, including:
 - a. Short-circuit
 - b. Voltage
 - c. Continuous current rating
 - 5. Fuse ratings and type (if applicable).
 - 6. Cable terminal (lug) sizes.
 - 7. Product datasheets.
- B. This Section hereby includes the applicable submittal requirements of Section, ELECTRICAL.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70, National Electrical Code and UL, latest editions, where applicable standards have been established.
- B. The switches and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards:
 - 1. NEMA KS-1.
 - 2. UL 98.
- C. Meet the applicable requirements of Section, ELECTRICAL.

PART 2 PRODUCTS

2.1 GENERAL

- A. This Section hereby includes the applicable general product requirements of Section, ELECTRICAL.
- B. Materials and equipment shall be first-quality new materials, free from any defects, and suitable for the intended use and the space provided. Provide materials that are UL listed, recognized, classified, or verified wherever standards have been established.
- C. Provide phenolic nameplates.
- D. Provide fuses as required.
- E. Safety switches shall bear a UL label.

- F. Refer to Section, ELECTRICAL, for general requirements on the following:
 - 1. Seismic requirements
 - 2. Standard products
- G. Disconnecting means, whether switches, circuit breakers, or connectors, shall be listed and rated for the intended use, shall be applied according to the recommendations of the manufacturer, and shall meet other applicable requirements of this Section.
- H. Manufacturer:
 - 1. Disconnect switches shall be manufactured by Cutler-Hammer, Square D, or equal.
 - 2. The listing of manufacturers does not imply acceptance of their products that do not meet specified ratings, features, or functions.

2.2 SAFETY SWITCHES

- A. Provide switches as shown on drawings, with the following ratings:
 - 1. 30 to 1200 amperes
 - 2. 250 volts ac, dc; 600 volts ac (30 A to 200 A 600 volts dc)
 - 3. 2, 3, 4 and 6 poles (2, 3 and 4 poles on 800 A; 2 and 3 poles on 1200 A)
 - 4. Fusible or non-fusible, as indicated
 - 5. Mechanical lugs suitable for aluminum or copper conductors.
- B. Construction
 - 1. Switch blades and jaws shall be visible and plated copper.
 - 2. Switches shall have a handle, pad-lockable in the OFF position.
 - 3. Switches shall have door interlocks that prevent the door from opening when the handle is in the ON position. Provide a defeater mechanism for this interlock.
 - 4. Switches shall have deionizing arc chutes.
 - 5. Switch assembly and operating handle shall be an integral part of the enclosure base.
 - 6. Switch blades shall be readily visible in the "ON" and "OFF" position.
 - 7. Switch operating mechanism shall be non-teasable, quick-make/quick-break type.
 - 8. Switches shall have line terminal shields (except for non-fusible double throw switches).
 - 9. Switches shall be suitable for systems capable of 100 kA at 600 V.
 - 10. Embossed or engraved ON-OFF indication shall be provided.
 - 11. Fused switches, where indicated on the drawings, shall be provided with current-limiting fuses, reinforced fuse clips, and rejection clips.
- C. Enclosures
 - 1. All enclosures shall be NEMA 12 for dry, indoor locations, NEMA 3R rainproof for wet, outdoor locations, or NEMA 4X, 316 stainless steel, watertight corrosion-resistant for corrosive areas, unless otherwise noted.
 - 2. Paint color shall be ANSI 61 gray for NEMA 3R and NEMA 12 enclosures; NEMA 4X, 316 stainless steel enclosures shall not be painted.

2.3 FUSES

- A. For fused switches, provide fuses matched to the application.
- B. Provide spare fuses, 10% of the installed fuses, minimum one set of each size/type.

2.4 NAMEPLATES

- A. Nameplates shall be provided for all disconnect switches, shall be front cover mounted, containing a permanent record of switch type, ampere rating, and maximum voltage rating.
- B. Refer to Section, ELECTRICAL IDENTIFICATION, for additional labeling requirements.

PART 3 EXECUTION

3.1 GENERAL

- A. Work shall be performed in a workmanlike manner by craftsmen skilled in the particular trade. Work shall be performed in accordance with the Drawings, Specifications, manufacturers' recommendations, and the best practice of the trade. Completed work shall present a neat and finished appearance.
- B. This Section hereby includes the applicable general execution requirements of Section, ELECTRICAL.

3.2 TESTING

- A. Coordinate testing with testing of other systems and equipment. Meet applicable requirements of Section, ELECTRICAL.

END OF SECTION

SECTION 265100 INTERIOR LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. This Section hereby includes the applicable general requirements of Section, ELECTRICAL.

1.2 SUMMARY

- A. This Section includes requirements for the following:
 - 1. Interior lighting fixtures, lamps, and ballasts.
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Lighting fixture supports.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. Luminaire: Complete lighting fixture, including ballast housing if provided.
- C. LER: Luminaire efficacy rating.

1.4 SUBMITTALS

- A. This Section hereby includes the applicable submittal requirements of Section, ELECTRICAL.
- B. Product Data: For each type of lighting fixture, arrange in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture, including dimensions.
 - 2. Emergency lighting units, including battery and charger.
 - 3. Ballast/Driver.
 - 4. Energy-efficiency data.
 - 5. Life, output, and energy-efficiency data for lamps.
 - 6. Photometric data, in IES format, based on laboratory tests of each lighting fixture type, outfitted with lamps, drivers, and accessories identical to those indicated for the lighting fixture as applied in this Project.
 - a. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
- C. Qualification Data: For agencies providing photometric data for lighting fixtures.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- F. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Meet the applicable requirements of Section, ELECTRICAL.
- C. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

- D. 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.

1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, piping and partition assemblies.

1.7 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Lighting Unit Batteries (Internal and External): 5 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining 4 years.
 - 2. Warranty Period for Self-Powered Exit Sign Batteries: 5 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining 4 years.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. This Section hereby includes the applicable general product requirements of Section, ELECTRICAL.

2.2 MANUFACTURERS

- A. Products shall be furnished in accordance with the Lighting Fixture Schedule on the Drawings.

2.3 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. LED Fixtures: Comply with UL 1598 and UL 8750. Where LER is specified, test according to NEMA LE6 and NEMA SSL4 as applicable.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 6 as applicable.
- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- F. 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.
- G. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85%.
 - 2. Specular Surfaces: 83%.
 - 3. Diffusing Specular Surfaces: 75%.
 - 4. Laminated Silver Metallized Film: 90%.

- H. Plastic Diffusers, Covers, and Globes:
 - 1. Acrylic Lighting Diffusers: 100% virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass, unless otherwise indicated.

2.4 LED DRIVER

- A. LED driver shall be installed in an electrical enclosure if not integral to fixture.
- B. Wiring inside enclosure shall comply with 600V/105 degrees rating or higher.
- C. LED driver shall comply with UL Standard UL1012.
- D. LED driver shall have Class A sound rating.
- E. LED driver shall be UL Certified for use in a dry or damp location, as required by the fixture's installation location.
- F. LED driver shall tolerate sustained open-circuit and short-circuit output conditions without damage.
- G. LED driver shall comply with the requirements of the FCC Rules and Regulations, Title 47, CFR Part 15, Non-Consumer (Class A).
- H. LED driver shall be suitable for 0-10V dimming.

2.5 LIGHT- EMITTING DIODE (LED) FIXTURES

- A. Luminaire shall have door frame and lens with LED arrays and integral airflow ventilation system.
- B. The light distribution pattern of the luminaires shall be suitable for a S/H ratio of approximately 1.8.
- C. The lighting system shall consist of the type and manufacturer as shown on the drawings or approved equal. If substitution fixtures are submitted, provide complete photometric calculations to demonstrate equivalent fixture performance.

2.6 EMERGENCY POWER UNIT

- A. General Requirements:
 - 1. Operate fixture continuously at an output of 1,400 lumens minimum for 90 minutes. Connect an unswitched leg of the associated lighting circuit to battery-inverter unit and switched circuit to fixture ballast/driver.
 - 2. Comply with UL 924
 - 3. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - 4. Remote Test: switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - 5. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.
- B. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with fixture.
 - 1. Test Pushbutton and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Pushbutton: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
- C. External Type: Self-contained, modular, battery-inverter unit, remote mounted from lighting fixture.
 1. Charger: Fully automatic, solid-state, constant-current type.
 2. Housing: NEMA 250, Type 1 enclosure.
 3. Test Pushbutton: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 4. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 5. Manufacturer:
 - a. Iota IIS-25-I or equal.

2.7 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with Authorities Having Jurisdiction.
- B. Internally Lighted Signs:
 1. Lamps for AC Operation: LED's, 70,000 hours minimum rated lamp life.
 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80% of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Pushbutton: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.8 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section, HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS, for channel- and angle-iron supports and non-metallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gauge.
- E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.9 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

- A. Reference Contract Drawing fixture schedule for fixture-specific requirements.

PART 3 EXECUTION

3.1 GENERAL

- A. Reference Contract Drawing fixture schedule for additional requirements.
- B. This Section hereby includes the applicable general execution requirements of Section, ELECTRICAL.

3.2 INSTALLATION

- A. See Drawings for additional installation/mounting requirements.
- B. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture, if applicable.
- C. Support for Lighting Fixtures In or On Grid-Type Suspended Ceilings: Do not use grid as a support element.
 - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
 - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
 - 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- D. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- E. Adjust aimable lighting fixtures to provide required light intensities.
- F. Connect wiring according to Section, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

3.3 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. 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.
- C. External emergency power units shall be located within manufacturer maximum limits of serving fixture. Mount external emergency power unit in an accessible location suitable for maintenance checks and service. Provide access panels where required.

END OF SECTION

SECTION 270500 COMMUNICATIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Electrical drawings schematically identify design intent. Coordinate with Owner for final locations and requirements.

1.2 WORK INCLUDED

- A. Section includes general requirements for communications.
- B. This Section hereby includes the applicable requirements of Section, RACEWAYS AND BOXES.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International. They assist in development of ANSI, EIA/TIA 568B.
- B. Cross-connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic Interference.
- D. IDC: Insulation Displacement Connector.
- E. LAN: Local Area Network.
- F. RCDD: Registered Communications Distribution Designer/BICSI Certified.
- G. RTPM: Registered Telecommunication Project Manager (BICSI Certified).
- H. UTP: Unshielded Twisted Pair.
- I. Patch cords: Short patch cables Cat 5/Cat 6 from patch panel to switch. Also known as "Intermediate; Cross Connects."
- J. Plenum-Rated: Insulation has a low smoke, low flame characteristic. Mandated in any air handling space.
- K. Main Distribution Frame (MDF): Primary data rack with patch panels. Typically in IT/Data (Server) Room.
- L. Intermediate Distribution Frame (IDF): Secondary data rack with patch panels. Typically in a remote closet, to collect premise wiring.
- M. MPOE (Main Point of Entry) primary point of connections for utility. Also known as "Entrance Facilities."

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer must have personnel certified by BICSI on staff. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs. Installer qualifications shall include the following capabilities:
 - 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD or Commercial Installer, Level 2.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when work of this Section is performed at Project site.
 - 3. Field Inspector: Currently registered by BICSI as RCDD or Level 2 to perform the on-site inspection.
- B. Comply with NFPA 70, National Electrical Code.
- C. Product Selection for Restricted Space. Comply with maximum dimensions and clearances where indicated.

- 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. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- F. Grounding: Comply with ANSI-J-STD-607-A.
- G. Plan, coordinate, and obtain approvals and inspections from all applicable agencies and Authorities Having Jurisdiction.
- H. Do not deliver or install any equipment until spaces are enclosed and weathertight, wet work in spaces is complete and dry and work above ceilings is complete.
- I. Contractor shall be a certified low-voltage cabling installer per CommScope Network Infrastructure System 25-year extended product and application warranty requirements.

1.5 CODES, PERMITS, AND REGULATIONS

- A. Do all work and install materials and equipment in accordance with the requirements of the National Electrical Code (NEC), NFPA 70, Oregon Electrical Specialty Code (OESC), Underwriters Laboratories (UL), applicable State and local laws and ordinances, and the power company.
- B. Conflicts, if any, that may exist among the above items, will be resolved at the discretion of the Engineer.
- C. Wherever the requirements of the Specifications or Drawings exceed those of the items above, the requirements of the Specifications or Drawings shall govern.
- D. The Owner requires that the Category 6, Category 3, and Fiber Optic portion of the cabling system comply with the proposed link and channel performance requirements of the latest revision of EIA/TIA 568-B.

1.6 SUBMITTALS

- A. General:
 - 1. Provide complete submittals as specified herein and as required to completely describe the equipment and systems being provided. Submittals for each specification section shall be complete, partial submittals will not be accepted.
 - 2. Generic submittals and full catalog submittals shall not be accepted. Submittals shall reflect items intended for installation only. Items intended for installation shall be identified within the submittal (tagged/highlighted).
 - 3. In addition to the schedule requirements herein, the Contractor is responsible for providing submittals in a timely manner as required to meet the overall project schedule.
 - 4. Should any item which deviates from these Specifications be included, the deviation shall be clearly indicated and explained at the time of submittal.
 - 5. Submittals shall be complete, neat, orderly, and include a Table of Contents with page numbers. The Contractor shall check submittals for number of copies, adequate identification, correctness, and compliance with the Drawings and Specifications, and shall initial all copies.
 - 6. Revise and resubmit all submittal information until acceptable to the Engineer.
 - 7. Resubmittals shall only include modified items to address SSI, R&R, and Rejected submittal review comments. Contractor shall not resubmit prior submitted content which has already been reviewed and engineer comments provided.
 - 8. Review of submittal information by the Engineer shall not relieve the Contractor of responsibility for meeting the requirements of the Drawings and Specifications or for errors and omissions in submittals.

B. Review Costs:

1. The Owner's cost for review of submittals for the same proposed materials, equipment, or work shall be apportioned as follows:
 - a. The cost of review of the initial submittal and the first revised submittal will be borne by the Owner.
 - b. The cost to review all additional revised submittals after the first revised submittal will be charged to the Contractor. The cost of review shall include, without limitation, administrative, design, and engineering activities directly related to review of submittals.
 - c. If a submittal is approved and the Contractor elects to submit an alternate item for review for the same application, the Contractor shall be responsible for the review costs for the alternative submittal. The cost of review shall include, without limitation, administrative, design, and engineering activities directly related to review of submittals.

C. Product Submittals:

1. Product submittals shall be submitted within 45 days after the Notice to Proceed. In addition, no products shall be purchased or shipped until the applicable submittals have been reviewed by the Engineer.
2. As-built copies of product submittals shall be included in the O&M manuals.
3. Before any material is fabricated or shipped, furnish to the Engineer full details, shop drawings, dimensions, catalog cuts, schematic diagrams, wiring diagrams, and other descriptive matter as required to fully described the equipment specified under this Section.
4. Submittals shall show that the products furnished meet the applicable UL standards for its intended use.
5. Provide submittals as called out in Section, SEISMIC AND WIND REQUIREMENTS FOR ELECTRICAL SYSTEMS, which demonstrate that design, fabrication, and installation of products meet the seismic requirements of that Section.
6. Drawing Requirements:
 - a. Drawings and data shall be complete and shall represent the equipment proposed for this Project. Drawings and data shall be adequate to demonstrate that the equipment meets the requirements of the Contract Drawings and Specifications, and also to be used by the Owner for operation, maintenance, and troubleshooting of the facility.
 - b. Interconnection diagrams shall show interconnection between devices and enclosures. Provide complete Project-specific interconnection diagram, which show the following for all power, control, signal, and communications interconnection:
 - 1) Terminal identification
 - 2) Wire numbers
 - 3) Conductor size, quantity
 - 4) Intermediate terminations
 - 5) Conduit/raceway designations
 - 6) References to corresponding enclosure wiring diagrams
 - 7) Pullboxes, handholes, and enclosures
 - c. In cases where existing systems are to be modified or connected to, drawings called for in this Section shall show existing items, modifications, and the points of interface. Drawings shall not be limited to new, but instead shall show new plus existing. Provide drawings which fully depict the final arrangement, plus annotate, or add detail to illustrate that the Contractor fully understands and

has a plan for cutting over to new systems. As-built drawings to be provided at the end of the project shall show the final arrangement only.

- d. Include terminal numbers and wire numbers which match terminal numbers and wire numbers on wiring diagrams, and on schematic diagrams. Include references to corresponding wiring diagrams.
- e. Provide complete drawings and descriptive data, both mechanical and electrical, for control panels.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.8 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. Provide O&M manuals within 20 days after the start of the Functional Acceptance Test (FAT). Include the following (both hardcopies and electronic copies):
 - 1. Corrected submittals as required herein.
 - 2. Record (as-built) Interconnection Diagrams and Equipment Drawings.
 - 3. For all equipment suppliers, list of current names, addresses, and telephone numbers of those who should be contacted for service, information, and assistance.
 - 4. Record (as-built) Contract Drawings marked with red pencil to show revisions when different from the original Contract Drawings. Prepare by obtaining new, clean sets of Contract Drawings from the Engineer, and pay all costs for same. Plans prepared using PDF markups are acceptable. For PDF markup plans, provide as-built plans in both hardcopy and electronic form to the Owner with the O&M manuals.
 - 5. Test results.
- B. The O&M manuals shall include operating and maintenance information for all subsystems and components covered in this Section. The O&M information shall be in sufficient detail to allow the operation, removal, installation, adjustment, and maintenance of each component provided under this Section.
- C. Each set of manuals shall be assembled in one or more three-ring binders, each with a title page, table of contents, and heavy section dividers with labeled index tabs. When more than one binder is required, the binders shall be labeled "Volume 1," "Volume 2," etc. The table of contents shall encompass the entire set of O&M manuals, shall list the contents of each volume, and shall appear in each binder.

1.9 COMMSCOPE NETWORK INFRASTRUCTURE SYSTEM 25-YEAR EXTENDED PRODUCT AND APPLICATION WARRANTY

- A. The Contractor shall have experience terminating CommScope Systimax products and be able to provide references for past work performed. The system warranty shall be facilitated by the Contractor and be established between the Owner and the cabling system manufacturer. Any deviation from this warranty must be approved by SOU prior to material product purchases or commencement of work.
- B. The Contractor shall maintain current status with the warranting manufacturer, including all training requirements, for the duration of the Project. Contractor shall register the project with Systimax prior to the commencement of the work. The Contractor shall staff each installation crew with the appropriate number of trained personnel, in accordance with the manufacturer warranty contract agreement, to support the 25-year Warranty requirements.
- C. After installation, the Contractor shall submit all documentation to support the warranty in accordance with the manufacturer's warranty requirements, and to apply for said warranty on behalf of the customer.

- D. The warranty coverage shall include all costs for labor, travel, lodging, and parts associated with the repair or replacement of any failed link within the warranty period for a valid warranty claim.
- E. Data network systems equipment and cabling products are listed in the following specification sections, per SOU. Verify with the warranting manufacturer that the products listed comply with warranty requirements. If a product does not comply, submit acceptable product and clearly identify the deviation during the submittal process.

PART 2 PRODUCTS

2.1 GENERAL

- A. Unless otherwise indicated, provide all first-quality new materials, free from any defects, and suitable for the intended use and the space provided. Provide materials that are UL listed, recognized, classified, or verified wherever standards have been established.
- B. Furnish and install all incidental items not specifically shown or specified which are required by good practice to provide the complete systems specified herein. This requirement includes installation and termination items for all premise wiring in the field and at the IT patch panels.
- C. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need to be products of the same manufacturer.

2.2 SEISMIC REQUIREMENTS

- A. Products shall be designed and fabricated to meet the applicable requirements of Section, SEISMIC AND WIND REQUIREMENTS FOR ELECTRICAL SYSTEMS. Product submittals shall confirm that product seismic requirements are satisfied. This requirement covers the following items:
 - 1. Cable trays
 - 2. Data racks
 - 3. Intermediate distribution frames
 - 4. Other items of weight 40 lbs or greater

2.3 STANDARD PRODUCTS

- A. Unless otherwise indicated, provide materials and equipment which are products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturer's latest design that conforms to these Specifications.

2.4 SUPPLY VOLTAGE DISTORTION

- A. Electrical (60-Hz) power supplied to equipment furnished under this Section may contain up to 10% harmonic distortion in voltage. All systems and equipment covered in this Section shall operate properly under this condition of supply voltage distortion.

2.5 FIELD QUALITY CONTROL

- A. Meet the applicable requirements of Section, TESTING AND IDENTIFICATION.
- B. Coordinate testing with testing of other systems and equipment.

PART 3 EXECUTION

3.1 GENERAL

- A. Work shall be performed in a workmanlike manner by craftsmen skilled in the particular trade. Work shall be performed in accordance with the Drawings, Specifications, manufacturer's recommendations, and the best practice of the trade. Completed work shall present a neat and finished appearance.
- B. Coordinate work with the other trades to avoid conflicts, errors, delays, and unnecessary interference during construction.
- C. This Section hereby includes the applicable requirements of Section, ELECTRICAL.

3.2 PROTECTION DURING CONSTRUCTION

- A. Throughout this Contract, provide protection for materials and equipment against loss or damage and from the effects of weather. Prior to installation, store items to be installed in indoor locations. Items subject to corrosion under damp conditions shall be stored in indoor, heated, dry locations.
- B. Following installation, protect materials, equipment, and insulation from physical damage, and moisture.
- C. Cap conduit runs during construction with manufactured seals. Keep openings in boxes or equipment closed during construction. Provide temporary heating source for equipment in damp locations or locations subject to condensation, until construction is complete, and equipment is energized.

3.3 MATERIAL AND EQUIPMENT INSTALLATION

- A. Follow the manufacturer's installation recommendations unless otherwise indicated. Follow the Engineer's decision, at no additional cost to the Owner, wherever any conflict arises between the manufacturer's instructions, State or other codes and regulations, and these Contract Documents. Always keep a copy of the manufacturer's installation instructions available on the jobsite for review.
- B. Install freestanding equipment in accordance with the manufacturer's recommendations. Secure freestanding equipment rigidly to floors with anchor bolts, expansion shields, or other approved means.
- C. Seismic Requirements:
 - 1. Installation of products provided under this Section shall meet the applicable requirements of Section, SEISMIC AND WIND REQUIREMENTS FOR ELECTRICAL SYSTEMS.
- D. Clearances:
 - 1. Coordinate the layout, fabrication, and installation of equipment and meet all applicable clearance requirements in front of and around equipment. Meet the requirements of the National Electrical Code, these Specifications, and the Authorities Having Jurisdiction. Obtain approvals from Authorities Having Jurisdiction, including the power company.
- E. Unless noted otherwise, pieces of freestanding equipment located adjacent to one another shall be installed such that the fronts line up.
- F. Provide engraved nameplates for all pieces of equipment. Plates shall be screw-on, 3-ply, black face, white 1/4-inch-high lettering.

END OF SECTION

SECTION 271310
COMMUNICATIONS CABLING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this section.
- B. This section hereby includes the applicable requirements of Section, COMMUNICATIONS.
 - 1. CommScope Network Infrastructure System 25-year Extended Product and Application Warranty specified in Section, COMMUNICATIONS, applies to all cabling specified as part of this Section. See 270500 1.9.

1.2 GENERAL

- A. This Section covers communications cabling. Applications on this project include the following:
 - 1. Site networking
 - 2. Telephone
 - 3. Video
 - 4. Access control systems
 - 5. Mass notification systems
 - 6. Lighting control
 - 7. HVAC/building automation
 - 8. Audio systems
 - 9. Wireless access device connectivity
- B. Intent of Drawings: Exact locations are not shown unless so indicated or specifically dimensioned.
- C. Departures from Drawings: Submit to the Engineer, in writing for review, details of any necessary proposed departures from these Contract Documents, and the reasons therefore, as soon as practicable and within 30 days after the award of the Contract. Make no such departures without the prior written approval of the Engineer.

1.3 DEFINITIONS

- A. See definitions in Section 27 05 00, COMMUNICATIONS. Below are specific definitions for this Section.
- B. Terms are segregated by products, applications, and other. Often a given product can be used in multiple applications.
- C. Product Definitions:
 - 1. Category 6 Cable: Twisted pair cabling, computer networks.
 - 2. Multi-mode Fiber Optic Cable: Large core diameter that enables multiple light modes to be propagated over short distances.
 - 3. Patch Panel: Termination of panel of premise cabling (data/voice) used for routing/interconnecting of computer network.
 - 4. Punch-down Block: 110 blocks, Bix blocks utilized for punch-down termination of premise wiring for distribution to other network systems. Premise Cabling: Is synonymous with horizontal cabling, and describes wiring within the facility, often from head end equipment to field outlets/jacks.
 - 5. Horizontal Cabling: see *Premise Cabling*.
 - 6. Backbone Cabling: Cabling between multiple items of head end equipment or major points of congregation of networking and systems

1.4 COORDINATION AND SCHEDULING

- A. The work specified in this Section requires extensive coordination with other project elements. Provide inputs to project schedules, including overall schedules and look-ahead schedules where specified. Plan and execute the work with consideration for overall project requirements, and realistic intervals for the work. Allow for investigations and development of shop drawings, realistic submittal reviews, time for procurement, fabrication, factory testing, field installations, testing, and other activities.

1.5 CODES, PERMITS, AND REGULATIONS

- A. Reference requirements in Section 27 05 00, COMMUNICATIONS.

1.6 SUBMITTALS, GENERAL

- A. General:
 - 1. Reference submittal requirements in Section 27 05 00, COMMUNICATIONS.

1.7 SUBMITTALS, SPECIAL REQUIREMENTS

- A. Provide application-specific submittal information as defined herein.
- B. Labeling Schedules:
 - 1. Provide electronic copy of labeling schedules, in software and format selected by Owner. Receive and review Owner's review comments.
- C. Color Convention:
 - 1. Develop and submit a proposed cable color convention for the Owner's review. Absent direction to the contrary, use the following:
 - a. Purple = Voice Communications Mass Notification
 - b. Yellow = Voice Communications (phone)
 - c. Green = Wireless access points
 - d. Red = Fire, security, emergency phones, life safety, elevator phone
 - e. Blue = Data communications
 - 2. Receive and incorporate the Owner's review comments.

1.8 QUALITY ASSURANCE

- A. Shall comply with CommScope Network Infrastructure System 25-Year Extended Product And Application Warranty.
- B. All cable shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the Contract Documents shall be subject to the control and approval of the Owner. Equipment and materials shall be of the quality and manufacturer indicated; except where industry standards are evolving, the products shall meet the latest standards. The equipment specified is based upon the manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval by the Engineer.
- C. Adhere to all NEC, NFPA, ANSI/TIA/EIA 569-B, BICSI, and other Standards that govern installation practices when installing cabling.
- D. Materials and work specified herein shall comply with the applicable requirements of:
 - 1. ANSI/TIA/EIA - 568-C Telecommunications Cabling Standard (including all the latest amendments and applicable addenda).
 - 2. ANSI/TIA/EIA - 569-B Pathway and Spaces.
 - 3. NFPA 70.
 - 4. BICSI Telecommunications Distribution Methods Manual.
 - 5. FCC 47 CFR Part 68.
 - 6. NEMA – 250.
 - 7. NEC - Articles 770 and 800.
 - 8. ADA - Americans with Disabilities Act.

9. ISO/IEC 11801 (International) Generic Cabling for Customer Premises Standard (including all the latest amendments and applicable addenda).
- E. Testing.
 1. This Section hereby includes the applicable general requirements of Section, TESTING AND IDENTIFICATION.
- F. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 50 or less.
- G. 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.
- H. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- I. Grounding: Comply with ANSI-J-STD-607-A and NFPA 70.

PART 2 PRODUCTS

2.1 MULTI-MODE FIBER OPTIC CABLE

- A. General
 1. Cables shall contain 12 multimode dual-window (850nm and 1,300nm) fibers. The optical fibers shall be contained within loose buffer tubes. The loose buffer tubes shall be stranded around an all-dielectric central member. Aramid yarn or fiberglass shall be used as a primary strength member, and a polyethylene outside jacket shall provide for overall protection.
 2. Splicing of fiber-optic cable is not allowed. Fiber breakouts shall be made with fiber patch panels (FPP's) as specified below.
 3. All fiber-optic (F/O) cable on this project shall be from the same manufacturer, who is regularly engaged in the production of this material.
 4. The cable shall be qualified as compliant with RUS Federal Rule 7CFR 1755.900.
 5. Fiber-optic trunk cable shall be Corning 012TUC-T4180D20, or equal.
 6. Manufacturers, or equal:
 - a. CommScope, Inc.
 - b. Corning Cable System.
 7. Comply with ICEA 5-83-596 for mechanical properties.
 8. Comply with TIA/EIA-568-B.3 for performance specifications.
- B. Physical Characteristics
 1. Fiber-optic trunk cable shall be all-dielectric, duct-type, with loose buffer tubes, and shall conform to these special provisions.
 2. All fibers in the buffer tube shall be usable fibers and shall be sufficiently free of surface imperfections and occlusions to meet the optical, mechanical, and environmental requirements of these Specifications. The required fiber grade shall reflect the maximum individual fiber attenuation to guarantee the required performance of each fiber in the cable.
 3. Shall be appropriate for the environment in which it is installed. The coating shall be UV-resistant. The coating shall be mechanically or chemically strippable without damaging the fiber.
 4. The cable shall comply with the optical and mechanical requirements over an operating temperature range of minus 40 degrees C to plus 70 degrees C, in accordance with EIA-455-3A (FOTP-3), "Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber-Optic Components."
 5. The fiber-optic cable shall withstand water penetration, in accordance with EIA-455-82 (FOTP-82), "Fluid Penetration Test for Fluid-Blocked Fiber-Optic Cable."

6. Crush resistance of the finished F/O cables shall be 3,000N/10cm, without showing evidence of cracking or splitting when tested in accordance with EIA-455-41 (FOTP-41), "Compressive Loading Resistance of Fiber-Optic Cables."
 7. The finished cable shall withstand a tensile load of 2,700N, in accordance with EIA-455-33 (FOTP-33), "Fiber-Optic Cable Tensile Loading and Bending Test."
- C. Transmission Characteristics:
1. Attenuation:
 - a. Multimode optical fiber cable as noted in Table 1 shall perform in accordance with the attenuation limits when tested per ANSI/EIA/TIA-455-78.
 2. Bandwidth:
 - a. Multimode fiber as noted in Table 1 shall perform in accordance with the bandwidth limits when tested per ANSI/EIA/TIA-455-204 or ISO/IEC 793-1-C2A.
 3. Transmission Distance:
 - a. The protocol pertinent to the transmission distance noted in Table 1 for multimode cable is Gigabit Ethernet per IEEE 802.3z.
 4. Zero Dispersion Wavelength and Slope:
 - a. Multimode cable shall perform in accordance with the Zero Dispersion wavelength and slope limits when tested per ANSI/EIA/TIA-455-175B.

Table 1 Minimum Performance Parameters for Multimode Fiber						
Fiber	Maximum Attenuation (dB/km)		Minimum Bandwidth (MHz-km)		Guaranteed Transmission Distance (m)	
	@ 850 nm	@ 1,300 nm	@ 850 nm	@ 1,300 nm	@ 850 nm	@ 1,300 nm
50/125	3.75 dB/km	1.5 dB/km	500 MHz/km	500 MHz/km	550 m	550 m
62.5/125	3.75 dB/km	1.5 dB/km	200 MHz	500 m	275 m	550 m

- D. Color-Coding
1. In buffer tubes containing multiple fibers, each fiber shall be distinguishable from others in the same tube by means of color-coding, according to the following:

a. Blue (BL)	g. Red (RD)
b. Orange (OR)	h. Black (BK)
c. Green (GR)	i. Yellow (YL)
d. Brown (BR)	j. Violet (VL)
e. Slate (SL)	k. Rose (RS)
f. White (WT)	l. Aqua (AQ)
 2. Buffer tubes containing fibers shall also be color-coded with distinct and recognizable colors according to the same table listed above for fibers.
 3. These colors shall be targeted in accordance with the Munsell color shades, and shall meet EIA/TIA-598, "Color Coding of Fiber-Optic Cables."

2.2 FIBER APPURTENANCES

- A. Manufacturers, or equal:
1. American Technology Systems Industries, Inc.
 2. Corning Cable Systems.
 3. Hubbell Premise Wiring.
- B. Fiber Patch Panel (FPP)
1. Strain relief shall be provided for the incoming fiber-optic cable. Cable accesses shall have grommets of rubber or similar material to prevent the cable from coming in

- contact with bare metal. All fibers shall be terminated and individually identified in the FPP.
2. Brackets shall be provided to spool the incoming fiber a minimum of two turns. Each turn shall not be less than 12 inches before separating out individual fibers to the splice tray.
 3. The fiber patch panel (FPP) distribution unit shall include modular fiber adapter panels (FAP's) to terminate all fibers with LC-type connector feed-through couplers.
 - a. FPP (Type 1) shall be Panduit FWME2, sole source.
 - b. FPP (Type 2) shall be Panduit FRME2U, sole source.
 - c. FAP's for FPP's Type 1 and Type 2 shall be FAP12WAQDLCZ, sole source.
 4. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- C. Optical Fiber Equipment Patch Cords:
1. Physical Characteristics:
 - a. Shall be available in standard lengths of 1, 3, and 5 meters, and custom lengths, and shall meet or exceed standards as defined in ANSI/TIA/EIA-568-C and ISO/IEC 11801.
 - b. Shall utilize duplex optical fiber cable that is 62.5/125 or 50/125 micron multimode, OFNR riser grade, and meets the requirements of UL 1666.
 - c. Shall utilize optical fiber cable where the attenuation shall not exceed 3.5 dB/km @ 850 nm wavelength or 1.0 dB/km @ 1,300 nm.
 - d. Shall have a cable jacket color for 62.5/125 in orange and 50/125 in orange.
 - e. Shall be equipped with SC or ST® in accordance with TIA/EIA-568-A and must include a ceramic ferrule.
 - f. Shall have terminated connectors that exhibit a maximum insertion loss of 0.75 dB with an average of 0.40dB when tested at either 850 nm or 1,300 nm wavelengths for 62.5/125 mm.
 - g. Shall have terminated connectors that exhibit a maximum insertion loss of 0.75 dB with an average of 0.50dB when tested at either 850 nm or 1,300 nm wavelengths for 50/125 mm.
 - h. Shall have a minimum return loss of 20 dB at both 850 nm and 1,300 nm.
 - i. Shall be made by an ISO 9001-Certified Manufacturer.
 - j. Shall be UL 1666 approved.
- D. Cable Connecting Hardware:
1. Comply with Fiber Optical Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 2. Connectors: Connectors shall be of the ceramic ferrule ST-to-LC type. Indoor ST-to-LC connector body housings shall be either nickel-plated zinc or glass-reinforced polymer construction. Outdoor ST connector body housing shall be glass-reinforced polymer.
 - a. The associated coupler shall be of the same material as the connector housing.
 - b. All F/O connectors shall be the 2.5-mm ST-to-LC connector ferrule type with Zirconia Ceramic material with a PC (physical contact) pre-radiused tip.
 - c. The ST-to-LC connector operating temperature range shall be minus 30 degrees C to plus 60 degrees C. Insertion loss shall not exceed 0.35 db, and the return reflection loss connectors shall be at least minus 20 dB. Connection durability shall be less than a 0.2-dB change per 500 mating cycles, per EIA-455-21A (FOTP-21). All terminations shall provide a minimum 222N pullout strength.
- E. OPTICAL FIBER MEDIA ADAPTERS
1. Physical Characteristics:
 - a. Shall be available in Office White and all TIA-606-A colors.

- b. Shall be flush mounted, flat, or angled design.
- c. Shall accommodate a minimum of three SC duplex style adapters (6 ports per adapter, or 12 ports per adapter when requested).
- d. Shall have options for both multimode and single-mode connectors.
- e. Shall be equipped with dust covers for unused ports (blank adapter plates).
- f. Shall be made of black steel plate material with snaps top and bottom.
- g. Shall be made by an ISO 9001-Certified Manufacturer.

2.3 CATEGORY 6 COPPER

- A. Cabling shall be 100-ohm unshielded twisted pair cable (UTP), 4-pair minimum.
- B. Cabling shall have insulation, appropriate for the environment in which it is installed (plenum or PVC).
- C. Transmission Characteristics:
 - 1. The following cable specifications shall be met by the cable manufacturer for UTP/ScTP Category 6 cables.

CABLE SPECIFICATIONS			
Cable Type:		Cat 6	Comments
Frequency Range:		1 mHz to 250 mHz	
1.	Attenuation: Worst-case	21.7dB	Note 1
2.	Worst-case near-end crosstalk (NEXT) Loss:	39.9dB	Note 2
3.	Worst-case power sum near-end crosstalk (PSNEXT) loss:	37.1dB	Note 2
4.	Worst-case equal level far-end crosstalk (ELFEXT):	15.3dB	Note 2
5.	Worst-case power sum equal level far-end crosstalk (PSELFEXT):	12.3dB	Note 2
6.	Worst-case return loss:	8dB	Note 2
7.	Worst-case propagation delay (ANSI/TIA/EIA-568C):	546ns	Note 3
8.	Worst-case delay skew (ANSI/TIA/EIA-568C):	25ns	Note 4
Notes: Cable shall exhibit values less than the values specified. Cable shall exhibit loss values greater than the values specified. Cable shall exhibit delays less than the values specified. Cable shall exhibit delays less than the values specified per 100 meters.			

2.4 CATEGORY 6 PATCH CORDS

- A. Category 6:
 - 1. Physical Characteristics:
 - a. Shall be round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted-pairs within a flame-retardant jacket.
 - b. Shall be equipped with modular 8-position plugs on both ends, wired straight through with standards compliant wiring.
 - c. Shall be backwards compatible with lower performing categories.
 - d. Shall use modular plugs, which meet or exceed FCC CFR 47 part 68, subpart F, and IEC 60603-7 specifications, and have 50 micro-inches minimum of gold plating over nickel contacts.
 - e. Shall have matching color strain relief boot with a snagless design which shall meet the flex test requirements of 1,000 cycles with boots and 100 cycles without boots.

- f. Shall be resistant to corrosion from humidity, extreme temperatures, and airborne contaminants.
- g. Shall utilize cable that exhibits power sum NEXT performance.
- h. Shall be available in any custom length and standard lengths of feet (3, 5, 7, 10, 15, 20, and 25 feet).
- i. Shall be made by an ISO 9001-Certified Manufacturer.
- 2. Electrical Specifications:
 - a. Shall have an input impedance without averaging: 100W + 15% from 1-100 MHz, + 22% from 100-200 MHz, and + 32% from 200-250 MHz.
 - b. Shall be 100% transmission tested for performance up to 250 MHz. Manufacturer shall guarantee cords are compatible with proposed Cat 6 links.
 - c. Shall utilize cable that is UL VERIFIED (or equivalent) for TIA/EIA proposed Category 6 electrical performance.
 - d. Shall be UL LISTED 1863.

2.5 CATEGORY 6 APPURTENANCES

- A. Manufacturers, or equal:
 - 1. American Technology Systems Industries, Inc.
 - 2. Hubbell Premise Wiring.
 - 3. Leviton Voice & Data Division.
 - 4. Panduit Corp.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 6 . Provide blocks for the number of cables terminated on the block, plus 25% spare. Integral with connector bodies, including plugs and jacks where indicated.
 - 1. Number of Terminals Per Field: One for each conductor in assigned cables.
- D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

2.6 WALL BOXES, JACKS

- A. CATEGORY 6 DATA/VOICE JACKS
 - 1. Physical Characteristics:
 - a. Shall be 8-position/8-conductor with 110 IDC termination.
 - b. Shall have both straight and angled mounting.
 - c. Shall be backwards compatible to allow lower performing categories of cables or connecting hardware to operate to their full capacity.
 - d. Shall provide universal application/multivendor support.
 - e. Shall support T568B standards wiring options.
 - f. Shall be constructed of high impact, flame-retardant thermoplastic.
 - g. Shall be made by an ISO 9001-Certified Manufacturer.
 - h. Shall be capable of accepting 24-26 AWG copper cable.
 - 2. Transmission characteristics:
 - a. Shall be UL VERIFIED (or equivalent) for TIA/EIA Category 6 electrical performance.
 - b. Shall be UL LISTED 1863 and CSA C22.2 approved or equivalent.
- B. FACEPLATES

1. Physical Characteristics:
 - a. Shall be available in single-gang and double-gang white configurations.
 - 1) Single Gang: 2.76" x 4.53" x 0.31"
 - 2) Double Gang: 4.53" x 4.60" x 0.31"
 - b. Shall be applicable for both fiber and copper applications.
 - c. Shall have designation labels for circuit identification, with a clear plastic cover.
 - d. Shall have, as a minimum, the standard colors of White, Gray, and Ivory.
 - e. Shall have optional modular furniture adapters available (stainless steel with 1-1/4-inch hole for split duct).
 - f. Shall have stainless steel options available.
 - g. Shall have surface-mount boxes and standoff rings available for both single- and double-gang faceplates.
 - h. Shall be made by an ISO 9001-Certified Manufacturer.
- C. Surface-Mount Boxes
 1. Physical Characteristics:
 - a. Shall be 6- or 12-port version with magnet-type attachment.
 - b. Shall have built-in cable management for both optical fiber and copper applications.
 - c. Shall accept modular Cat-5e and Cat-6 jacks, as well as all media adapters.
 - d. Shall be available in White, Gray, and Ivory.
 - e. Shall have at least three sides with breakouts and an opening in the base for cable or raceway entry.
 - f. Shall have a designation area for printed or adhesive labels for circuit identification with clear plastic protector.
 - g. Shall have color-coded designations for jack identification.
 - h. Shall be made by an ISO 9001-Certified Manufacturer.
- D. Multimedia Outlet (Wall-Mount)
 1. Physical Characteristics:
 - a. Shall be surface mounted.
 - b. Shall provide either single-gang with 6 ports, or double-gang with 12 ports.
 - c. Shall be available in White, Gray, and Ivory.
 - d. Shall be capable of accepting SC-type connectors for optical fiber; 8-position/8-conductor modular jacks for 100W UTP/ScTP cable, 2-position/4-conductor USOC voice jacks, and data jacks Category 5e or higher, and other multimedia adapters.
 - e. Shall be capable of integrating UTP/ScTP, fiber, and connectivity outlets.
 - f. Shall have an undercover labeling system compliant with TIA/EIA-606-A administrative standards.
 - g. Shall have rear cable access and at least three sides with breakouts for cable/raceway entry with strain relief points.
 - h. Shall have storage capacity for at least 1 meter (3.28 feet) of fiber and 305 mm (12 inches) for UTP slack storage, while maintaining minimum bend radius requirements.
 - i. Shall allow information outlets to pass through openings before or after termination.
 - j. Shall be made by an ISO 9001-Certified Manufacturer.
- E. Wall Phone Jack Assembly
 1. Physical Characteristics:
 - a. Shall be constructed of stainless steel.
 - b. Shall have mounting lugs designed to mate with corresponding telephone baseplate or adapter.

- c. Shall mount to single-gang outlet box or to wall directly.
- d. Shall be a RJ14C jack.
- e. Shall be wired to USOC BU/WH, OR/WH pair 1&2.

2.7 BACKBOARDS

- A. Reference Section 27 11 00, COMMUNICATION EQUIPMENT ROOM FITTINGS.

PART 3 EXECUTION

3.1 MINIMUM REQUIREMENTS

- A. The type of cables required for each application are generally called out on the plans, and/or in notes. These requirements are generally minimal.
- B. In all cases, provide cabling and termination provisions suitable for the application and meeting the manufacturer's recommendations of the systems which the cables serve.
- C. For cases where cable types are not called out on the plans or otherwise, cabling shall meet the following minimum requirements:

Application	Minimum Requirement
Premise Cabling	Category 6
Backbone Cabling	Multimode fiber

3.2 ENTRANCE FACILITIES

- A. Coordinate cabling demarcation provisions with the service product(s). Submittals shall include evidence of coordination, and installation requirements.
- B. Existing 450-pair communication cable entering building form tunnel shall be terminated to 110-blocks mounted on wall in basement IT Room. Provide 50 pair communication cable from 110 punchdown block and terminate at MDF rack.
- C. Existing single-mode and multi-mode, 12 strand fiber cables shall be terminated at fiber patch panels at MDF rack.

3.3 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters . Conceal raceway and cables where possible.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Section, RACEWAY AND BOXES.
- B. Wiring Method: Conceal conduits, conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring Within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.4 PATHWAYS (RACEWAYS)

- A. Install cables in raceways in all of the following cases:
 - 1. Concealed in walls soffits, chases, or hard-lid inaccessible ceiling spaces.
 - 2. Exposed, except for special cases so noted elsewhere.
 - 3. Underground
- B. Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pullbox sizing and length of conduit and number of bends between pull points. But in no case exceed 270 degrees total bends in any given run.
- D. Comply with requirements in Section, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS, for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

- F. Cables in accessible ceiling spaces shall be installed on "J" hooks, unless specified otherwise. Cables shall be supported every 4 feet on center, minimum, in concealed areas.
- G. Cables exposed in open ceiling spaces shall be installed on "J" hooks, mounted at 3-foot intervals. Cables shall be tightly bundled, with minimal sag in cable bundle between "J" hook supports. Installation shall result in a clean and organized appearance, ran parallel or perpendicular to structural elements.
- H. Cables shall be installed as above, with cables being exposed in only the following cases:
 - 1. Within computing equipment rooms.
 - 2. Where the equipment/devices are suitable only for exposed cable final connections. Examples and computers, peripherals, and devices and equipment for which raceway points of connection are not feasible.
 - 3. When using patch cords/cables for final termination:
 - a. Regardless, cable routing and bundling, etc., as specified herein shall result in protected, serviceable installations.

3.5 CABLE INSTALLATION

- A. Comply with NECA 1.
- B. General Requirements:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at outlets, terminals, cross-connects, and patch panels.
 - 5. Cables may not be spliced.
 - 6. For visible cables, secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 7. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" chapter. Use lacing bars and distribution spools.
 - 9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
 - 10. Install cable in neat and workmanlike manner. Neatly bundle and tie all cable in closets. Leave sufficient cable for 90-degree sweeps at all vertical drops.
 - 11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 12. In computing equipment rooms, data centers, and closets, install a 10-foot-long service loop on each end of cable.
 - 13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
 - 1. Comply with TIA/EIA-568-B.2.
 - 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
 - 1. Comply with TIA/EIA-568-B.3.
 - 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

3. Each cable reel shall have a durable weatherproof label or tag showing the manufacturer's name, the cable type, the actual length of cable on the reel, the Contractor's name, the Contract number, and the reel number. A shipping record shall also be included in a weatherproof envelope showing the above information and shall also include the date of manufacture, cable characteristics (size, attenuation, bandwidth, etc.), factory test results, cable identification number, and any other pertinent information.
 4. Installation procedures shall be in conformance with the procedures specified by the cable manufacturer for the specific cable being installed. The Contractor shall submit the manufacturer's recommended procedures for pulling fiber-optic cable, at least 20 working days prior to installing cable. Mechanical aids may be used provided that a tension-measuring device and a break-away swivel are placed in tension to the end of the cable. The tension in the cable shall not exceed 2,225N or the manufacturer's recommended pulling tension, whichever is less.
 5. During cable installation, the bend radius shall be maintained at a minimum of 20 times the outside diameter. The cable grips for installing the fiber-optic cable shall have a ball bearing swivel to prevent the cable from twisting during installation.
 6. F/O cable shall be installed using a cable-pulling lubricant recommended by the F/O cable and/or the conduit manufacturer. Contractor's personnel shall be stationed at each vault/pullbox through which the cable is to be pulled to lubricate and prevent kinking or other damage.
 7. F/O cable shall be installed without splices. A minimum of 6 feet of slack shall be provided for each F/O cable at each FPP. Slack shall be divided equally on each side of the FPP.
 8. Pulling a separate F/O cable into a spare duct to replace damaged fiber will not be allowed.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches above ceilings by J-hooks not more than 48 inches <Insert dimension> apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Installation of Cable Routed Exposed Under Raised Floors:
1. Install plenum-rated cable only.
 2. Install cabling after the flooring system has been installed in raised floor areas.
 3. Coil cable 6 feet <Insert size> long not less than 12 inches <Insert size> in diameter below each feed point.
- G. Group connecting hardware for cables into separate logical fields.
- H. Separation From EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in non-metallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2kVA and 5kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

- a. Electrical Equipment Rating Less Than 2kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2kVA and 5kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5kVA: A minimum of 12 inches.
- 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2kVA: No requirement.
 - b. Electrical Equipment Rating between 2kVA and 5kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5kVA: A minimum of 6 inches.
- 5. Separation between Communications Cables and Electrical Motors and Transformers, 5kVA or 5hp and larger: A minimum of 36 inches.
- 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.6 FIRESTOPPING

- A. Comply with requirements in Section, PENETRATION FIRESTOPPING. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" article.
- C. Firestop all openings where cable is installed through a fire barrier.

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section, LABELING STANDARD.
 - 1. Administration Class: 2.
 - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- C. Cable and Wire Identification:
 - 1. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 2. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.

3.8 FIELD QUALITY CONTROL

- A. Coordinate testing with testing of other systems and equipment. Meet applicable requirements of Section, TESTING AND IDENTIFICATION.
- B. Perform tests and inspections.
- C. Inspections:
 - 1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

END OF SECTION

**SECTION 272100
LABELING STANDARD**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. This Section hereby includes the applicable general requirements of Section, COMMUNICATIONS.
- C. Refer also to Section, ELECTRICAL IDENTIFICATION.

1.2 WORK INCLUDED

- A. This Section includes guidelines for labeling new Telecom cabling and equipment.

1.3 QUALITY ASSURANCE

- A. All new labeling shall coincide with current Owner labeling practices. New installations that require additional methods will revert to the following (contact the Owner's representative for clarification):
 - 1. ANSI/TIA/EIA 606A standards and UL 969 for a system of labeling materials, including label stocks, laminating, adhesives, and inks used by label printers.
- B. Meet the applicable requirements of Section, COMMUNICATIONS.

1.4 SUBMITTALS

- A. Provide printed samples of intended labeling materials to be used. Contractor shall present samples for approval before application in the Project.
- B. Labeling shall be approved by the Owner's representative prior to final acceptance of a project.
- C. This Section hereby includes the applicable submittal requirements of Section, COMMUNICATIONS.

PART 2 LABELING

2.1 GENERAL

- A. This Section hereby includes the applicable general product requirements of Section, COMMUNICATIONS.

2.2 CONTRACTOR RESPONSIBILITY

- A. All labeling schemes for telecommunication components device faceplates, patch panels, termination blocks, cables, etc., shall be coordinated with the Owner.
- B. Verify all IT room names with the Owner prior to labeling. Match numbering with construction drawings of final room labeling scheme.

2.3 LABEL TYPES

- A. Permanent labels shall be:
 - 1. Utilized for all outlets, termination blocks, patch-panels, distribution junction boxes, and cables of all telecommunication service media.
 - 2. Of a composite/configuration that is difficult to remove, peel off, or fade by exposure of natural elements.
- B. Self-adhesive vinyl labels for raceways carrying circuits at 600V or less. Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating. Label shall have black text on white printing area and clear "tail" that self-laminates the printed area when wrapped around the cable. If cable jacket is white, provide cable label with printing area that is any color other than white, preferably orange or yellow – so that the labels are easily distinguishable.

- C. Apply labels with care and replace immediately if they begin to peel, tear, or fade away from their mounted surface.
- D. Contractor may contract the services of labeling manufacturer/supplier, provided a final product is approved by the Owner before applied in the field.
- E. Labels shall be produced of a UV-resistant material and sealed to prevent encroachment of environmental elements from destroying the label when located outside.

2.4 CROSS-CONNECT FIELD LABELING

- A. BIX'S Blocks:
 - 1. Labeling strips for work area station cable runs shall be 4-pair demarcated and **BLUE** in color.
 - 2. Labeling strips for emergency phones, alarm circuits, and similar services shall be 4-pair demarcated and **RED** in color.
 - 3. Labeling strips for entrance cable (inter-building) or cable that ties directly back to the main distribution frame (MDF) and designated MPOE shall be 5-pair demarcated and **GREEN** in color.
 - 4. Labeling strips for intra-building (IDF to IDF) and inter-building backbone cable shall be 5-pair demarcated and **WHITE** in color.
 - 5. Labeling strips for inter-building backbone cable that ties directly back to a PBX, switch, or similar common equipment shall be 5-pair demarcated **PURPLE** in color.

2.5 FACEPLATES (VOICE AND DATA)

- A. Faceplate window shall include source IT Room, rack number, and patch panel number.
Example:

MDF-101

- B. All faceplate ports must contain a sequential numbering scheme beginning with an odd number.
- C. Faceplates without label windows shall have a label at the top-left corner of the outlet device after mounting outlet into position.

2.6 PATCH PANELS – GENERAL DATA

- A. Patch panels shall be labeled with IT room tag name (MPOE, MDF, IDF), rack number, and patch panel number. Examples below:

“MDF-101

(Rack 1, Panel 01)”

Legend:

MDF = IT Rack Source

1 = Rack number

01 = Patch Panel Number

- B. Each port on the patch panel shall be clearly labeled with a unique sequential number.

2.7 CABLE (COPPER AND FIBER CABLING)

- A. Labeling of copper cables with 25 pair or more conductors, or all fiber-optic cables shall contain source location, destination, unique cable numbers and quantity of conductors, Contractor's name, date installed, and cable type. Example:

“MPOE/MDF-01 (25C)”

Contractor's Name:

Date Installed:

Cable Type:

- B. Labeling of fiber-optic cables with six or more strands of fiber shall contain the source location, destination, unique cable number, quantity of conductors, Contractor's name, date installed, and cable type. Example:

"MPOE/MDF-01 (25MMF)"

MM = Multimode

Contractor's Name:

Date Installed:

Cable Type:

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS FOR ALL CABLES

- A. Label each end of cable within 4 inches of termination.
- B. Label cable inside all junction boxes, pullboxes, vaults, enclosures, and rooms.
- C. Label cables on each floor and in each room the cable is openly visible.
- D. Utilize cable ties on labels, place labels in full view of personnel viewing cable identifiers, and if several cables are bundled together or run side-by-side, all labels shall be at the same level height.
- E. Exposed cables and cables in cable trays shall be labelled at intervals not exceeding 15 feet.
- F. Cable label shall be cut and sized to the cables outer sheath.

3.2 PATCH PANEL LABELS

- A. All labels shall be printed and placed on the front of patch panel horizontally.

3.3 PATCH PANEL ADAPTERS

- A. Typical labels for single and duplex SC connectors adapters.
 - 1. All ports and/or bulkheads shall have two sets of labels.
 - 2. All labels shall be printed horizontally and placed onto the panel cover.

3.4 MAINTENANCE PULLBOXES

- A. All maintenance pullboxes shall be labeled with a unique number or identifier defined by the Owner. The number or identifier shall:
 - 1. Be clearly stamped into the rim or frame of all pullboxes.
 - 2. Be weatherproof, wearproof, legible, and visible at all times.
 - 3. Be the largest font size that the installer can fit into the rim or frame.
- B. The labeling effort is the direct responsibility of the installing contractor.

END OF SECTION

SECTION 272200
TESTING AND IDENTIFICATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. This Section hereby includes the applicable general requirements of Section, COMMUNICATIONS.

1.2 WORK INCLUDED

- A. This Section includes the minimum requirements for testing of, certification administration, and identification of backbone and horizontal cabling.

1.3 QUALITY ASSURANCE

- A. Meet the applicable requirements of Section, COMMUNICATIONS
- B. All testing procedures and testers shall comply with applicable requirements of:
 - 1. TIA/EIA TSB-67 Field Testing of UTP (including the latest amendments and applicable addenda).
 - 2. TIA/EIA 568-C Annex H (including the latest amendments and applicable addenda).
- C. Identification and administration work specified herein shall comply with the applicable requirements of:
 - 1. ANSI/TIA/EIA – 606-A Administration Standards (including the latest amendments and applicable addenda).
 - 2. ANSI/TIA/EIA - 569-B Pathway and Spaces.
 - 3. ANSI/TIA/EIA - 568-C Telecommunications Cabling Standard (including the latest amendments and applicable addenda).
 - 4. BICSI Telecommunications Distribution Methods Manual.
- D. Comply with NFPA 70.
- E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

1.4 SUBMITTALS

- A. This Section hereby includes the applicable submittal requirements of Section, COMMUNICATIONS.
- B. Manufacturers' catalog sheets and specifications for fiber and copper cable testers.
- C. Test reports.

PART 2 PRODUCTS

2.1 GENERAL

- A. This Section hereby includes the applicable general product requirements of Section, COMMUNICATIONS.
- B. Perform testing of the existing 50 pair (part of 450 pair) building communication entrance cabling. Coordinate testing and testing requirements with SOU Representative and SOU IT Staff. Validate each used pair is functioning properly.
- C. Perform testing of the single-mode and multi-mode 12 strand fiber optic cables between the SOU Computer Services Building and the MDF rack. Coordinate testing and testing requirements with SOUR Representative and SOU IT Staff. Validate each fiber optic cable is functioning properly.

2.2 OPTICAL FIBER CABLE TESTERS

- A. Multimode Optical Fiber Light Source:
 - 1. LED light sources shall be 850nm and 1,300nm +/-20nm wavelength.
 - 2. Spectral width of sources shall be <= 50nm for 850nm wavelengths and <= 140nm for 1,300nm wavelengths.
 - 3. The output of the light source shall be 8 MW for 62.5um core optical fiber.
 - 4. Output stability +/-0.40 dB from 0 degree to 50 degrees C.
 - 5. Long-term output stability +/-0.10 dB at 25 degrees C.
 - 6. Power shall be from rechargeable Ni-Cad batteries.
 - 7. Connector types shall include: SMA, FC, ST, and SC.
- B. Power Meter:
 - 1. Test capability shall be 850nm, 1,300nm, and 1,500nm +/-20nm wavelength.
 - 2. Measurement range shall be from 10 dBm to -60 dBm.
 - 3. Accuracy shall be +/-5% at 0 dBm to -50 dBm and +/-10% 10 dBm to 0 dBm and -50 dBm to -60 dBm.
 - 4. Resolution shall be 0.1 dB.
 - 5. Connector types shall include: SMA, FC, ST, SC, LX.5.
 - 6. Optical Time Domain Reflectometer (OTDR).
 - 7. Shall have a front CRT display.
 - 8. Connector types shall include: SMA, FC, ST, SC, LX.5.

2.3 COPPER 100-OHM UNSHIELDED TWISTED PAIR (UTP) TESTERS

- A. Shall provide electronic user interface records.
- B. Shall date stamp all tests.
- C. Physical interface shall be modular RJ-45 connector and a serial port with DB-9 connector.
- D. Shall have auto-testing to determine if cable meets the requirements of TIA/EIA TSB-67 standards.
- E. Shall use injector for complete wire mapping and TDR for determining cable length.
- F. Shall measure NEXT for all pair combinations and attenuation on all pairs from 1.0 MHz to 250 MHz.

2.4 LABELS

- A. Meet the applicable requirements of Section, LABELING STANDARD.
- B. Shall be preprinted or laser printed type.
- C. Where used for cable marking, provide vinyl substrate with black text on a white printing area and a clear "tail" that self-laminates the printed area when wrapped around the cable. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow - so that the labels are easily distinguishable.
- D. Where insert-type labels are used, provide clear plastic cover over label.
- E. Provide plastic warning tape 6 inches wide continuously printed and bright colored 18 inches above all direct-buried services, underground conduits, and ductbanks.

PART 3 EXECUTION

3.1 GENERAL

- A. This Section hereby includes the applicable general execution requirements of Section, COMMUNICATIONS.

3.2 TESTING

- A. Incorporate the items specified in this Section into the Functional Acceptance Test (FAT). Coordinate testing with testing of other systems and equipment.

3.3 MANUFACTURER'S REPRESENTATIVE

- A. Arrange for a technical representative of the manufacturer to attend precommissioning checkout of the equipment and to instruct the operating personnel in the operation, shutdown, startup, and maintenance of the equipment.

3.4 OPTICAL FIBER CABLE TESTING

- A. Test all fibers with launch and receive cable of sufficient length for the OTDR to be able to see through all installed connectors.
- B. Power meter test both directions.
- C. Localized attenuation shall not exceed 0.5 dB at any point.
- D. Backbone multimode fiber shall be tested in one direction at both 850nm and 1,300nm in accordance with ANSI/TIA/EIA-526-3.
- E. Backbone single-mode fiber shall be tested in one direction at both 1,310nm and 1,550nm in accordance with ANSI/TIA/EIA-526-3.
- F. Multimode fiber shall conform to the following:

850nm:		1,300nm:	
<u>Length (meters)</u>	<u>Attenuation (dB)</u>	<u>Length (meters)</u>	<u>Attenuation (dB)</u>
500	3.5	500	2.2
1,000	5.5	1,000	3.0
1,500	7.5	1,500	3.8
2,000	9.0	2,000	4.5

- G. Single-mode fiber shall conform to the following. (Note: Taken at 1,550nm):

Inside: @1,550nm		Outside:	
<u>Length (meters)</u>	<u>Attenuation (dB)</u>	<u>Length (meters)</u>	<u>Attenuation (dB)</u>
500	2.0	500	1.8
1,000	2.5	1,000	2.0
1,500	3.0	1,500	2.2
2,000	3.5	2,000	2.5
2,500	4.0	2,500	2.8
3,000	4.5	3,000	3.0

3.5 COPPER 100-OHM UTP CABLE TESTING

- A. General:
- The testing parameters called for in this Section shall apply for up to 90 meters of cable, a work area equipment cord, an RJ45 outlet, and two cross-connect connections in the closet. Testing shall be done with a Fluke 4000, 2000, Pentascanner, Microtester, TDR-type testers that provide TDR and wire map test records.
 - Test cable with test set to match the nominal velocity of propagation (NVP) for the cable as stated by the cable manufacturer of the cable being installed.
 - The test parameters shall include Wire Map, Length, Attenuation, and near-end crosstalk (NEXT).
 - The Bit error rate (BER) shall not exceed 10⁻¹⁰.
- B. Wire Map:
- The wire map test shall verify pair to pin termination at each end and check for connectivity errors. The wire map shall indicate the following for each of the eight conductors:
 - Continuity to the remote end.
 - Shorts between any two or more conductors.
 - Crossed pairs.

- d. Reversed pairs.
 - e. Split pairs.
 - f. Any other wiring issues.
- C. Cable Length:
- 1. The maximum length of the test link, including the test equipment cords, shall be 94 meters.
- D. Testing:
- 1. The link ATTENUATION and NEXT of all cables shall be tested. The link is the sum of the attenuation of all connecting hardware, 10 meters of patch and equipment cords, and 90 meters of cable. The following tables indicate acceptable values:
 - 2. Copper Testing:
 - a. UTP Impedence:
 - 1) DC Resistance: The dc resistance of any conductor shall not exceed 9.0 ohms per 100 meters at, or corrected to, a temperature of 20 degrees C.
 - 2) DC Resistance Unbalance: The dc resistance unbalance between two conductors of any pair shall not exceed 3% when measured at, or corrected to, a temperature of 20 degrees C.
 - 3) Capacitance: The capacitance of any pair at 1 kHz and measured at, or corrected to, a temperature of 20 degrees C shall not exceed 15 pf per foot nominal.
 - 4) Impedance: The cable shall have a typical input impedance meeting the following values based on swept cable input measurements only. Curve fitting or smoothing functions shall not be utilized to improve the values.

Input Impedance: (CAT6)	
1.0 - 20.0 MHz	100 +/- 12 Ohms
20.0 - 200.0 MHz	100 +/- 15 Ohms
200.0 - 310.0 MHz	100 +/- 20 Ohms
310.0 - 350.0 MHz	100 +/- 22 Ohms
Impedance (CAT6)	
Frequency (MHz)	Impedance Spec (ohms)
1.0	100 +/- 12
4.0	100 +/- 12
8.0	100 +/- 12
10.0	100 +/- 12
16.0	100 +/- 12
20.0	100 +/- 12
25.0	100 +/- 15
31.25	100 +/- 15
62.5	100 +/- 15
100.0	100 +/- 15
155.0	100 +/- 15
200.0	100 +/- 15
250.0	100 +/- 20
350.0	100 +/- 22

- b. Return Loss (RL): The RL values shall be greater than or equal to the values shown below, based on swept frequency cable input measurements only. Curve fitting or smoothing shall not be utilized to improve the values.

Return Loss (RL) (/6)	
Frequency (MHz)	Min Return Loss (dB)
1.0	20.0
4.0	23.0
8.0	24.5
10.0	25.0
16.0	25.0
20.0	25.0
25.0	24.3
31.25	23.6
62.5	21.5
100.0	21.0
155.0	21.0
200.0	31.0
250.0	18.0
350.0	17.0

- c. CAT6 Attenuation: The attenuation is derived from swept frequency signal level measurements at the output of cable lengths greater than or equal to 100m (328 feet). The maximum attenuation of any pair, in dB per 100m, measured at or corrected to a temperature of 20 degrees C, shall be less than or equal to the values calculated from the following equation (for a frequency range of 1 MHz to 350 MHz). The values listed in the table are for information only and are calculated from the equation:

$$\text{Attenuation} = 1.808 * \text{Sqrt}[\text{freq}] + 0.017 * \text{freq} + 0.05 / \text{Sqrt}[\text{freq}]$$

Attenuation (6)	
Frequency (MHz)	Attenuation (dB/100m)
0.772	1.7
1.0	1.9
4.0	3.7
8.0	5.3
10.0	5.9
16.0	7.6
20.0	8.4
25.0	9.5
31.25	10.7
62.5	15.5
100.0	19.9
155.0	25.3
200.0	29.1
250.0	33.0
350.0	40.0

- d. CAT6 Power-Sum Near End Crosstalk (PSNEXT): PSNEXT loss is derived from swept frequency measurements using a network analyzer and a s-parameter test set. The minimum PSNEXT loss for any pair combination at room temperature shall be greater than or equal to the value determined using the following equation. The values listed in the table are for information only and are calculated from the equation:

$$PSNEXT(f) = 74 \text{ dB} - 15 \log(\text{freq}/0.772)$$

(PSNEXT) (6)	
Frequency (MHz)	Min PSNEXT (dB)
0.772	74.0
1.0	72.3
4.0	63.3
8.0	58.8
10.0	57.3
16.0	54.3
20.0	52.8
25.0	51.3
31.25	49.9
62.5	45.4
100.0	42.3
155.0	39.5
200.0	37.8
250.0	36.3
350.0	34.2

- e. CAT6 Power Sum Equal Level Far End Crosstalk (PSELFEXT): PSELFEXT loss is derived from swept frequency measurements using a network analyzer and a s-parameter test set. The minimum PSELFEXT loss for any pair combination at room temperature shall be greater than or equal to the value determined using the following equation. The values listed in the table are for information only and are calculated from the equation:

$$PSELFEXT(f) = 67 \text{ dB} - 20 \log(\text{freq}/0.772)$$

PSELFEXT (6)	
Frequency (MHz)	Min PSELFEXT (dB/100 m)
0.772	67.0
1.0	64.8
4.0	52.7
8.0	46.7
10.0	44.8
16.0	40.7
20.0	38.7
25.0	36.8
31.25	34.9
62.5	28.8
100.0	24.8
155.0	20.9
200.0	18.7
250.0	-
300.0	-
350.0	-

- f. Propagation Delay: The propagation delay of any pair at 10 MHz shall not exceed 510ns/100m.
- g. Propagation Delay Skew: The propagation delay skew between any two pairs shall not exceed 18ns/100m at 10 MHz.
- h. Powersum Attenuation to Crosstalk Ratio (ACR) dB/100m.

Powersum Attenuation to Crosstalk Ratio (6)	
Frequency (MHz)	Min Psum ACR (dB/100m)
0.772	72
1.0	70
4.0	59
8.0	53
10.0	51
16.0	46
20.0	44
25.0	42
31.25	39
62.5	30
100.0	25
155.0	16
200.0	10
250.0	3
300.0	>0
350.0	-

3.6 LABELING AND IDENTIFICATION

- A. Comply with requirements in Section, LABELING STANDARD.

3.7 DATA REPORTING AND ACCURACY

- A. General:
 - 1. A Pass or Fail result for each parameter shall be determined by the allowable limits for each parameter. If the test result of a parameter is closer to the test limit than the accuracy of the tester, it shall be marked with an asterisk. Data at all measured points shall be uploaded to a PC and printed on a laser printer.
- B. Wire Map:
 - 1. Wire map tests shall be marked "pass" if wiring is determined correct.
- C. Length:
 - 1. Test results shall be provided in meters and marked "pass" or "fail" based on the length vs. allowable length.
- D. Attenuation:
 - 1. Report the attenuation value and the frequency at point of failure, or the highest frequency passed. Measured attenuation values lower than 3 dB shall not be used for a pass/fail determination. Report the attenuation per unit length for links longer than 15 meters.

- E. NEXT:
1. Report the NEXT value and "pass" or "fail" for each sample based on the following requirements:

NEXT	
Frequency Range (MHz)	Maximum Step Size (MHz)
1 - 31.35	0.15
31.25 - 100	0.25

3.8 RECORD COPY AND AS-BUILT DRAWINGS

- A. Provide computer-generated reports in Word format that details each communication path from the outlet to the patch panel. Format report with one test result per page in ascending order. Provide hardcopy and electronic files to Owner.
- B. Provide record copy Drawings periodically throughout the project or as requested by the Project Manager and at end of the Project.
- C. Record copy Drawings shall include notations reflecting the as-built conditions of any additions to, or variations from, the base Specifications and Drawings provided.
- D. Test Results:
 1. Copper Cabling: The Contractor shall test all cables and submit all copper cable test result data in electronic format, with the resulting file formatted with one test result per 8.5" x 11" page. Export or download the test results from the cable tester to a *.txt format.
 - a. High Pair Count Copper Cables:
 - 1) The Contractor shall test all high count copper cables and submit test result information in an electronic file. Acceptable formats are Microsoft Word or Microsoft Excel. See Project Manager for required format for test report documentation.
 2. Fiber Optic Cabling: The Contractor shall test all fiber optic cables and submit all fiber test result data in electronic format, with the resulting file formatted with one test result per 8.5" x 11" page. Export or download the test results from the cable tester to a *.txt format. Hardcopy shall show test results graphically for the entire length of the fiber.
 - a. Reports shall show circuit ID, cursor marks, total attenuation, date of installation, and test used.
 - b. Contractor shall submit a copy of software capable of viewing the electronic test result files.

CABLE SPECIFICATIONS			
Cable Type:		Cat 6	Comments
Frequency Range:		1 mHz to 250 mHz	
1.	Attenuation: Worst-case	21.7dB	Note 1
2.	Worst-case near-end crosstalk (NEXT) Loss:	39.9dB	Note 2
3.	Worst-case power sum near-end crosstalk (PSNEXT) loss:	37.1dB	Note 2
4.	Worst-case equal level far-end crosstalk (ELFEXT):	15.3dB	Note 2
5.	Worst-case power sum equal level far-end crosstalk (PSELFEXT):	12.3dB	Note 2
6.	Worst-case return loss:	8dB	Note 2
7.	Worst-case propagation delay (ANSI/TIA/EIA-568C):	546ns	Note 3
8.	Worst-case delay skew (ANSI/TIA/EIA-568C):	25ns	Note 4

CABLE SPECIFICATIONS		
Cable Type:	Cat 6	Comments
Frequency Range:	1 mHz to 250 mHz	
Notes: Cable shall exhibit values less than the values specified. Cable shall exhibit loss values greater than the values specified. Cable shall exhibit delays less than the values specified. Cable shall exhibit delays less than the values specified per 100 meters.		

END OF SECTION

SECTION 280001
FIRE ALARM SYSTEM PERFORMANCE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. This Section hereby includes the applicable general requirements of Section, ELECTRICAL.

1.2 WORK INCLUDED

- A. This Project consists of a design-build contract for the Southern Oregon Central Hall. This Specification Section covers design-build performance requirements for additions to an existing manual/automatic fire alarm system. Fire alarm system was installed as part of a prior phase of work. Components not specifically listed in this Section or shown on the Drawings, but which are required for proper operation of the system, shall be provided. The Project shall include the following line items as part of the bid.
 - 1. Fire alarm signal panel (FASP)
 - 2. Fire alarm system initiating devices
 - 3. Fire alarm notification devices
 - 4. Mass notification devices
 - 5. Annunciator
 - 6. Coordinate with other peripheral system interconnection requirements (HVAC control panel, access control panel, mass notification system, etc.)
- B. Fire alarm control panel shall communicate with other building systems (see Sheet E7.1, Detail 1). Field investigate and confirm interface with each system identified below is present:
 - 1. Mass notification system
 - 2. Access control system
 - 3. Fire sprinkler system (flow, tamper switch)
 - 4. HVAC control panel
 - 5. FACP and FASP systems on other floors.
- C. Furnish all material, labor, and equipment to achieve performance in accordance with applicable codes and standards and to the best practices of the industry.
- D. Design/build fire alarm system is limited to the second floor. Other floors were addressed as part of a prior phase of work.

1.3 REFERENCES

- A. Fire alarm system design, work, and installation of materials and equipment shall be in accordance with the requirements of local laws, ordinances, the utility purveyors, Authorities Having Jurisdiction, and State codes listed below.
 - 1. NFPA 72 – National Fire Alarm Code with Oregon Amendments
 - 2. UFC – Uniform Fire Code
 - 3. Life Safety Code
 - 4. National Electrical Code
 - 5. Oregon Electrical Specialty Code
 - 6. Oregon Fire Code
 - 7. State Fire Marshal
- B. Conflicts, if any that may exist among the above items will be resolved at the discretion of the Project Engineer.

1.4 REQUIREMENTS

- A. Fire alarm system shall be compatible with system installed as part of prior phases of work (basement/first floor).
- B. The Fire Alarm Contractor shall prepare a design, complete, meeting the requirements of the Contract Documents, under a deferred approval process. The design and installation shall meet the requirements of the Authorities Having Jurisdiction, including the Building Department and the State Fire Marshal. The system and all components shall be listed by Underwriter Laboratories, Inc., for use in Fire Protective Signaling systems under the following standards as applicable:
 - 1. UL 38 – Manually Actuated Signaling Boxes
 - 2. UL 50 – Cabinets and Boxes
 - 3. UL 268 – Smoke Detectors for Fire Protective Signaling Systems
 - 4. UL 268A – Smoke Detectors for Duct Applications
 - 5. UL 346 – Waterflow Indicators for Fire Protective Signaling Systems
 - 6. UL 464 – Audible Signaling Appliances
 - 7. UL 521 – Heat Detectors for Fire Protective Signaling Systems
 - 8. UL 864 – Control Units for Fire Protective Signaling Systems
 - 9. UL 1481 – Power Supplies for Fire Protective Signaling Systems
 - 10. UL 1971 – Visual Signaling Appliances
- C. It is the sole responsibility of the Fire Alarm Contractor to obtain approvals of the Authorities Having Jurisdiction. As described in this Specification, provide a complete shop drawing package to the State Fire Marshal, and if required, to the local Building Department.
- D. Develop all documentation described under submittals, and other documentation as required.
- E. The design shall be coordinated among trades and sources of supply.
- F. Following approval by the Authorities Having Jurisdiction, submit the approved design package to the Owner's representatives for review.
- G. Prior to rough-in, conduct a pre-installation conference as described in this Specification.
- H. An emergency warning system with visual strobe devices is required for the hearing impaired and shall be provided.
- I. Provide smoke detectors for operation of smoke dampers, duct detectors with test switch to shut down air conditioning equipment, and protection of openings in fire-rated partitions. New smoke detectors and associated smoke dampers are limited to ductwork installed as part of this project, existing ductwork locations are not included in the Contractor's Scope.
- J. Verify monitoring of sprinkler system flow, tamper switches, and backflow preventer are present. Add monitoring of sprinkler system flow to updated fire sprinkler system on Second Floor.
- K. Fire alarm system shall be an addressable system, network communication (BACnet) capable. Connect new FASP to existing Fire Alarm Control Panel for full system communication.
- L. Fire Alarm and Mass Notification device locations shown on the drawings are schematic where shown. Locations shall be coordinated during pre-installation conference as described in this Section.
- M. System shall be capable of one-way paging through ceiling speakers. Paging shall be initiated at the FACP, FASP, at SOU Central Station, and any paging device connected to SOU network.
- N. Coordinate with SOU staff and verify second floor paging zone requirements. Provide all programming and startup necessary to integrate with complete paging system.
- O. New FASP shall be networked with the existing building and campus fire alarm control system and be capable of communicating with all other campus networked fire panels. See drawings and SOU Representative for additional information.
- P. Fire alarm control panel shall provide an alarm signal to the building's access control system.
- Q. Provide a general building alarm signal output from the FACP to the HVAC control panel.

- R. The work shall not be started until the detailed Drawings, Specifications, and engineering calculations have been accepted and approved by the State Fire Marshal. Contractor shall provide approved copy to the Engineer.
- S. Conform with NFPA 72, UFC, and Document Drawings. Where conflict exists between applicable code and Document Drawings, comply with the stricter requirement.
- T. Operator control of the fire alarm system shall be possible at the fire alarm control panel (FACP) and at the annunciator. Operator control includes arming or disarming the system acknowledging alarms and observing system status. Coordinate annunciator location with the Owner.
- U. All field circuits shall be supervised. Field circuit failure shall occur on open circuit, closed circuit, or foreign grounded circuit. On field wiring failure, the operator shall be able to discern the source of the failure on the control panel. In the event of alarm system trouble arising from field circuit failure, logic unit failure, or loss of 60-Hz power, then an alarm shall be reported.

1.5 SUBMITTALS

- A. This Section hereby includes the applicable submittal requirements of Section, ELECTRICAL.
- B. Provide complete detailed design submittal to the State Fire Marshal within 14 days of the Notice-to-Proceed. The detailed design submittal shall include the following, minimum:
 - 1. Description of project: Include location/address, Owner's name, and telephone number; and supplier's name, address, and telephone number.
 - 2. Indicate what type of system is being provided.
 - 3. Provide catalog data, SFM listing number, and model number for every fire alarm system component.
 - 4. Indicate the conduit sizes, quantity, and type of conductors, and whether the system is power limited or non-power limited.
 - 5. Provide Drawings:
 - a. Symbol legend for devices shown on submitted Drawings.
 - b. Floor plans showing locations of all fire alarm equipment/devices.
 - c. Riser Diagrams.
 - d. Battery calculations for the entire system (24-hour standby, 5-minute alarm time).
 - e. Voltage drop calculations for both initiating and signal circuits.
 - f. FACP Panel Layout Drawings.
 - g. Elevation views showing device installations.
 - h. Sequence of operation/events matrix: including arming/disarming, audible alarming, visual indications, and acknowledge sequencing.
 - i. Details:
 - 1) Support/anchorage of equipment.
 - 2) Fire-rated wall penetrations.
 - 6. Submit a FACP, FASP, and Annunciator device naming and display list for the Owner's review. List shall include a summary of connected devices, locations, and how they will appear on the FACP and Annunciator panels, at a minimum. Area tag-names shall be logical and adhere to the Contract Documents. Area naming convention (see plans).
 - 7. Submit system documentation to Authorities Having Jurisdiction for approval. Revise submittal as required and obtain written approval from the Fire Marshal. Submit letter of approval for Engineer review.
- C. No products shall be fabricated or shipped until the applicable submittals have been reviewed and approved by the Authority Having Jurisdiction.

1.6 SUBMITTALS FOR INFORMATION

- A. NFPA 72 system test report.

1.7 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Meet the applicable requirements of Section, ELECTRICAL.
- C. Installer: Authorized by manufacturer to install and service products furnished under this Section.
- D. It will be the responsibility of the fire alarm contractor to ensure proper specification adherence for system operation, final connection, test, turnover, warranty compliance, and after-market service. The installer of the equipment specified must be factory-trained and certified.
- E. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment, and devices shall be tested and listed by a Nationally recognized testing organization in accordance with the latest NFPA 72 edition with State amendments.
- F. All equipment and components shall be installed in strict compliance with manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
- G. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. Fasteners and supports shall be adequate to support the required load.
- H. The installing contractor shall provide a copy of current documentation, indicating that the subcontractors installing fire alarm systems or devices, are certified by Underwriters Laboratories (UL) in its product directories under the listing category, "PROTECTIVE SIGNALING SERVICES – LOCAL, AUXILIARY, REMOTE STATION, AND PROPRIETARY." The fire alarm equipment installing contractor must also provide complete installation of all wiring and equipment.

1.8 PRE-INSTALLATION FIRE ALARM CONFERENCE

- A. Convene pre-installation conference prior to installation of back boxes and raceway components to support fire alarm devices. The Fire Alarm Contractor shall provide copies of design documents to participants in the conference.
- B. Attendees:
 - 1. General Contractor
 - 2. Electrical Subcontractor
 - 3. Architect and Engineer
 - 4. Owner (Owner's Representative)
 - 5. Fire Marshal
 - 6. Fire Alarm Contractor
- C. Notify Architect and Engineer 7 working days prior to meeting.
- D. Prepare agenda and preside at meeting. Include the following topics:
 - 1. Review locations, mounting heights, and installation requirements for all devices.
 - 2. Review interconnection requirements.
- E. Document final locations, connection points, and mounting heights where at variance with Drawings. Distribute documentation to affected subcontractors and to the Architect and the Engineer.

1.9 WARRANTY

- A. The work and materials covered in this Section shall be guaranteed for a period of 1 year from the date of acceptance thereof against defective materials, design, and workmanship.
- B. Warranty coverage shall include any and all costs for labor, travel, lodging, and parts.

PART 2 PRODUCTS

2.1 GENERAL

- A. This Section hereby includes the applicable general product requirements of Section, ELECTRICAL.

- B. Unless otherwise indicated, provide all first-quality new materials, free from any defects, and suitable for the intended use and the space provided. Provide materials that are UL listed, and NFPA approved. Materials for the fire alarm system shall be approved by the Fire Marshal having jurisdiction.
- C. Refer to Section, ELECTRICAL, for general requirements on the following:
 - 1. Seismic requirements
 - 2. Standard products
 - 3. Supply voltage distortion
 - 4. Equipment finish
 - 5. Enclosures

2.2 OWNER DEVICE STANDARDS

- A. The following device specifications are Owner's standard. Any deviations shall be clearly stated during submittals for review by Owner.
 - 1. Addressable Devices:
 - a. Individual device annunciations shall be available at the control panel.
 - b. Annunciation shall include the following conditions for each point: Alarm, Trouble, Open, Short, Device Missing/Failed ground fault.
 - c. Shall have the capability of being disabled or enabled individually.
 - d. Up to a total of 250 addresses shall be available with a minimum of 100 address points. Field programming shall allow addresses to be added or dropped as required.
 - e. Communication reliability is provided by parity data bit error checking and checksum routines.
 - f. Device addresses must be set by rotary switch settings.
 - 2. Fire alarm signal panel manufacturer shall be Silent Knight by Honeywell or equal.
 - a. Cabinet to be surface mount with hinged door.
 - b. Horizontal width limited to a maximum of 2'-0" and vertical height allowable from floor to ceiling.
 - c. Panel accessories (notification appliance batteries, etc.) are to be in line vertically with control panel within control cabinet.
 - d. New panel shall be provided with 75% spare capacity for future system devices.
 - e. New panel shall be keyed to a University cat-15 key.
 - f. Fire alarm panels and system devices must be reconcilable within 30 minutes of installation or reinstallation without requiring program changes.
 - 3. Fire alarm control panel shall be compatible with existing Southern Oregon University Campus fire alarm and mass notification network.

PART 3 EXECUTION

3.1 GENERAL

- A. This Section hereby includes the applicable general execution requirements of Section, ELECTRICAL.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and NFPA 72.
- B. The fire alarm/life safety installation shall comply fully with all local, State, and National codes, and the local Authority Having Jurisdiction.
- C. Install cable in conduit in spaces above gypsum board ceilings and soffits.
- D. Do not run cable or conduit exposed, except where concealed conduit installation is not possible.
- E. Program FACP/FASP to meet local Fire Marshal requirements.

- F. Support cable independently of ceiling members, ceiling support wires, pipes, conduits, and air conditioning ducts.
- G. Install conduit under provisions of Section, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.
- H. All wiring shall be in accordance with the Oregon Electrical Specialty Code (OESC), NFPA 70 (National Electrical Code), local codes, and National Fire Protection Association Standard No. 72 with State amendments.
- I. Fire alarm control panel and all other equipment shall be mounted with the center of all operable reset buttons, located a maximum of 48 inches front approach/54 inches side approach above floor level.
- J. The fire alarm control panel and power supply shall be connected to a dedicated branch circuit, maximum 20 amperes. This circuit shall have a red handle with lock-on device and labeled as FIRE ALARM.
- K. Fire sprinkler activation detecting system(s) shall each be indicated on a separate zone in the fire alarm control panel.
- L. A terminal cabinet shall be installed on each floor for the fire alarm system. All fire alarm wiring shall terminate on UL-approved strips in this terminal cabinet. All wiring shall be labeled at each termination strip. Wiring shall be configured such that all end-of-line resistors will be installed at the terminal cabinet.
- M. Arrange wiring neatly cut to proper length and remove surplus wire. Bundle wires with tie straps or other suitable product, and tie down securely. Hinge wiring and wiring that will be subjected to bending during maintenance or other operations shall be arranged so that any wire bending or twisting will be around that longitudinal axis of the wire. Where wires or cables pass through holes or across edges of sheet metal, rubber grommets shall be installed in order to prevent insulation chafing.
- N. Wiring shall not be spliced or tapped except at device terminals, on terminal blocks, or at approved "T" connections for SLC loops.
- O. Furnish and install Isolated Loop Circuit Protectors (ILCP) on communication and signaling lines, including shields on all circuits that extend beyond the building by any means.
- P. The ILCP shall be located as close as practicable to the point at which the circuits enter or leave a building.
- Q. The ILCP grounding conductor shall be No.12 AWG wire having a maximum length of 28 feet in as straight a line as practicable and connected to the building unified ground per NFPA 70.
- R. The ILCP shall have a line response time and an earth response time of less than 1 nanosecond, capable of accepting 2000 amps (8 x 20μs pulse).
- S. The ILCP shall be protected by a high dielectric insulating material and be of physical size to allow mounting in a standard 4-11/16-inch square and 2-1/8-inch-deep electrical box.
- T. Spark gap devices or devices incorporated in or installed within the Fire Alarm control panel in lieu of the specified ILCP are not acceptable.
- U. Wiring and conduit arrangement shall be supplied by vendor in shop drawings.
- V. Wire installed must be approved by the manufacturer for Power Limited fire alarm use per NFPA 70.
- W. Final connections between the equipment and the wiring system shall be made under the supervision of a representative of the equipment manufacturer.
- X. The systems specified under this Section shall be complete. Furnish and install all incidental items not specifically shown or specified which are required by good practice to provide the complete systems specified herein.

3.3 FIELD QUALITY CONTROL

- A. Coordinate testing with testing of other systems and equipment. Meet applicable requirements of Section, ELECTRICAL.
- B. Test in accordance with NFPA 72.
 - 1. Testing shall demonstrate that the entire system functions as intended. All inputs, outputs, statuses, and alarms shall be verified to work under normal, trouble, and alarm conditions. At a minimum, the test shall include the following:
 - a. All wiring shall be tested for proper connection, continuity, and resistance to ground.
 - b. All system components shall be tested as part of the system and shall be in accordance with the manufacturer's recommended procedures and NFPA procedures.
 - c. Each detector and field device shall be tested by a factory-trained technician in accordance with the manufacturer's recommended procedures.
 - d. The systems shall perform in these specified tests to the satisfaction of the Engineer and the Fire Marshal. Any deficiencies found in the system shall be corrected by the Contractor prior to the proceeding with subsequent tests. If the alarm equipment fails any of the above tests, the Contractor shall submit documentation which fully describes modifications of the system necessary to meet the requirements of this Specification. The Contractor shall make all necessary modifications at no additional cost to the Owner, then repeat testing.
 - e. After completion of the performance test, the Contractor shall prepare a test report and shall submit it for review.
- C. As a part of this Contract, the Contractor shall return to provide 100% test of all devices and the operation of the system, including battery tests, after a period of 1 year from the final acceptance of the system. The test shall meet current guidelines as established by NFPA. All test results shall be documented, and results provided to the Owner. All defective parts shall be replaced at no cost to the Owner.
- D. Provide three copies of operation and maintenance manuals. Manuals shall include the following:
 - 1. Equipment suppliers
 - 2. Service contact names, addresses, and telephone numbers
 - 3. Record (as-built) Contract Drawings marked in red pencil to show work revisions
 - 4. Test reports

3.4 OWNER TESTING, TRAINING, AND WARRANTY/CLOSEOUT REQUIREMENTS

- A. A written Acceptance Test Procedure (ATP) shall be provided for demonstration/training on the system and certification of proper system operation. In coordination with the SOU Facilities Management and Planning (FMP) Representative, the ATP shall be prepared by the contractor and submitted to the FMP office for approval four (4) weeks or more prior to the performance of the ATP that includes the following requirements.
- B. Prior to inspections/testing with the City of Ashland a 100% test of the entire system is required with the FMP Representative. If this 100% test in an occupied building test must occur during off hours when the building is empty.
- C. Scheduling and performance of final inspection & testing with the Fire Marshall must be coordinated with the FMP Representative and building occupants.
- D. If the results are not satisfactory to FMP, the corrections will be made, and a retest will be required at the contractor's expense prior to City inspection.
- E. Contractor representative and fire alarm technician shall be present for all testing and the fire alarm technician shall conduct the testing.
- F. Testing will be performed in accordance with NFPA 72 and the City of Ashland's requirements.

- G. Training:
1. Vendor and installing Contractor shall conduct training session(s) during which maintenance and operational aspects of the system will be described and demonstrated to personnel selected by the FMP Representative.
 2. The session(s) shall be conducted by a manufacturer's representative and installing Contractor thoroughly familiar with the characteristics of the installed system.
 3. Owner shall be provided with a minimum of 8 hours training of the installed system after all startup and testing procedures have been completed and as-built documentation delivered.
 - a. Minimum hours of required training may increase based upon the system size and complexity.
 - b. Training will include both an overview for Campus Public Safety staff and building occupants and an in-depth review/training session for FMP Representative.
- H. Closeout, Warranty, and Support:
1. With as-builts, record drawings, O&M manuals, etc. deliverables a complete list is required of all system devices, power packs, etc. noting their installed locations.
 2. Reviewed and accepted record drawings will be available for verification purposes. Record drawings and performance testing are conditions for substantial completion.
 3. Guarantee all work against faulty and improper material and workmanship for a minimum of 1-year from the date of final written acceptance by the FMP Representative, except where guarantee or warranties for longer terms are clearly requested and specified.
 4. Upon notification of a problem, the warranty provider shall furnish within 48 hours at no cost to the Owner such labor and materials as are needed to restore the system to proper operation.
 5. During the entire 1-year warranty period the Contractor must guarantee a 4-hour response time for problem resolution.
 6. During the entire 1-year warranty period the Contractor must provide all related software upgrades to the installed system(s).
 7. At end of the 1-year warranty period, with the FMP Representative present, the Contractor is to conduct a 1-year inspection and provide a report of system equipment and system operational functions.
 8. In addition to the 1-year system warranty, any software changes and/or updates that impact the life safety and/or panel function must be provided at no cost to the Owner for the additional period of 3 years.

END OF SECTION

SECTION 281300
ELECTRONIC ACCESS CONTROL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes.
 - 1. The section includes requirements for access control.

1.2 SUBMITTALS

- A. Contractor shall submit all the product data in Division 28 at the same time. Piecemeal submittals will be rejected as incomplete.
 - 1. A submittal is required for each product specified.
 - 2. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
- B. Product Data
 - 1. Pursuant to Section 01300 Submittal Procedures.
 - 2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

1.3 WORK INCLUDED

- A. This project consists of a design-build contract for the Southern Oregon University's Central Hall. This Specification Section covers design-build performance requirements for a complete Electronic Access Control System. Components not specifically listed in this Section or shown on the Drawings, but which are required for proper operation of the system, shall be provided. The Project shall include the following line items as part of the bid
 - 1. Head end equipment.
 - 2. End devices.
 - 3. Power Supplies.
- B. Furnish all material, labor, and equipment to achieve performance in accordance with applicable codes and standards and to the best practices of the industry.
- C. This project includes a remodel for the second floor of a multi-story building. The basement and first floor were remodeled under a separate Contract. The access control system needs to include spare capacity or be expandable to meet future buildout requirements.
- D. Conduct workshops with the SOU Representative to determine what the future buildout requirements may be for the basement and second floor.
- E. Provide an access control system with new headend equipment, which supports new and existing field devices.
- F. Coordinate new access control system/devices with existing system installed as part of a prior phase of work. New system shall be compatible with existing components to create a single cohesive access control system.

1.4 FIELD INVESTIGATIONS

- A. Perform a pre-bid walkthrough with Owner staff to assess the Owner's existing electronic access control equipment for interface with the new system. See 2.2 EXISTING EQUIPMENT. See Detail 1 on Sheet E7.2.
- B. Field investigate and document existing exterior door access control components, wiring, and wiring interception points.

1.5 DEMARCATION REQUIREMENTS

- A. The CONTRACTOR shall provide all the conduit, conductors, cabling components and accessories necessary for a complete system.

1.6 CONTRACTOR DESIGN BUILD RESPONSIBILITIES

- A. The CONTRACTOR shall be responsible for providing a design/build of the access control system. The CONTRACTOR shall provide the following:
 - 1. Product data and technical literature on all devices, components, hardware, and wiring used for the system.
 - 2. Scaled floor plans, showing all system devices, equipment, circuits, and homeruns.
 - 3. Single line diagrams of the system hardware. The single line diagram shall be specific to this project. Typical or generic single line diagrams shall not be acceptable.
 - 4. Cabling diagram showing cable routing.
 - 5. The CONTRACTOR shall design and provide all conduit and wiring to achieve the following:
 - a. Receive signal from the fire alarm control panel during fire alarm general building alarm.
 - b. Control designated door operation through access control devices.
 - c. Facility lockdown via Facility's Control Station. Coordinate with OWNER for requirements.
 - 6. Demonstration, training, and commissioning.
 - 7. The CONTRACTOR shall coordinate the installation of the access control system with the OWNER.

1.7 INTENT OF THE DRAWINGS AND SPECIFICATIONS

- A. The access control system drawings are schematic and are intended to show the approximate location of devices and equipment as well as the general alignment of conduits and piping.
- B. CONTRACTOR shall provide all labor, materials, equipment, machinery, and tools necessary to provide all electrical equipment specified and shown on the Drawings. All items not specified in detail or shown on the Drawings but necessary for complete installation shall be provided by the CONTRACTOR.

1.8 WARRANTY

- A. All parts and labor shall be warrantied to the OWNER for a period not less than 5 years from the date of substantial completion.
- B. Warranty shall be in the OWNER's name.
- C. Contractor shall provide any software maintenance patches and version updates or upgrades at no-additional costs to OWNER for a period of at least 1 year.

1.9 SPARE PARTS

- A. Deliver to the OWNER in its original packaging, one spare of each component.
- B. Spares shall be housed in an environment and condition recommended by the manufacturer and shall be clearly labeled with "SPARE: DO NOT REMOVE", manufacturer part number, and date of delivery to the OWNER.
- C. All packaging for spares must be kept in good condition and used as appropriate for any Returns to Manufacturer (RMA).

PART 2 PRODUCTS

2.1 MATERIALS

- A. The products specified herein are the basis of design and the OWNER's Standard. Provide all materials required for a complete and operable system.

- B. Products shall be approved by the designated SOU Facilities Management And Planning (FMP) Representative on the project.
- C. Access Control Systems (ACS):
 - 1. The ACS system installed under this scope of work shall provide controlled access to building interior and real-time monitoring of doors at multiple locations simultaneously.
 - 2. The ACS system shall be controlled by FMP Lock Shop existing computer system. ACS system hardware installed under this scope must be compatible with current version and allows future upgrades.
 - 3. The ACS building controllers shall be LAN addressable and shall be connected to FMP Lock Shop provided Ethernet receptacles.
 - 4. At reader doors where power assist devices are located, the ACS system shall shunt the exterior power assist operator button while door is locked so that it may only be used with valid card presentation to protect power assist drive assembly.
 - 5. The ACS system shall control primary access points to be determined with each project and requires
 - 6. FMP Lock Shop review and approval.
 - 7. All doors controlled by ACS shall be equipped with request-to-exit (REX) devices and door contracts.
 - 8. Required Submittals:
 - a. Manufacturer's specifications and technical data for all components.
 - b. List of programming decisions that need to be made by the FMP Lock Shop for proper operation of the system. Included in this list shall be all console/local passwords or access codes as well as any proposed field-assigned passwords or access codes.
 - c. Panel and power supply drawings layouts on backboard allocated for ACS in telecommunications closet. Indicate desired location of 120 VAC power receptacles on this drawing for coordination.
 - d. One-line diagram showing all devices, controllers, and cable types between device.
- D. The CONTRACTOR is responsible to coordinate the cabling requirements between devices with the requirements and best practices. The cabling shall be shielded.
- E. The CONTRACTOR shall be an approved factory authorized representative of the manufacturer and shall be responsible for all programming and configuring of the system required for a complete and operational system.
- F. System Controller
 - 1. Vanderbilt VCRNX-A.
- G. Reader Interface
 - 1. Shall be provided with a lockable enclosure.
 - 2. Provide Vanderbilt model No. VRINX with VLOCK.
- H. Wall Mount FOB Reader
 - 1. Shall be black in color.
 - 2. Shall be provided with tamper resistant Torx screws for cover.
 - 3. Provide AptiQ Model No. MT15.
- I. Request to Exit
 - 1. Shall be black in color.
 - 2. Provide Bosch DS161, OWNER's Standard, no substitutions.
- J. Power Supplies
 - 1. Shall be Altronix Model No. AL600 Series.
- K. Backup Batteries
 - 1. Shall be Expert Power Model No. EXP1270.

- L. Door Contact
 - 1. Shall be 3/4" diameter, round in shape.
 - 2. Shall be white.
 - 3. Provide GRI 180-12WG-WH.
- M. Electric Strike:
 - 1. Exit device (push bar) regular door cylinder.
 - 2. Provide electric strike compatible with specified system.

2.2 EXISTING ELECTRONIC ACCESS CONTROL SYSTEM

- A. SOU owns and maintains an existing electronic access control system at Central Hall. New equipment and controllers shall be compatible with existing equipment installed on First and Basement floors.

PART 3 EXECUTION

3.1 ELECTRONIC ACCESS CONTROL SYSTEMS (ACS) INSTALLATION

- A. Access Control Systems (ACS) Installation:
 - 1. Quality Assurance: All workers involved with this installation must have completed manufacturer training and have a minimum of 2-years' experience installing like equipment or have a minimum of 5 years of installation experience with specified equipment.
 - 2. Install all equipment and cabling in a manner consistent with manufacturer recommendations and instructions.
 - 3. Install all devices and components shown on drawings required for proper operation of the system.
 - 4. Mount devices level and in a uniform fashion.
 - 5. Install FMP Lock Shop furnished post bases for card readers in coordination with concrete pours. Also coordinate installation and pours with required power.
 - 6. Contractor shall furnish and install all cabling associated with the operation of the ACS system.
 - 7. Contractor shall **not** pull any ACS cables in conduits containing or intended to contain voice and data wiring.
- B. Starting Access Control (ACS) Equipment & Systems:
 - 1. Coordinate with FMP Lock Shop for setup of Ethernet network and IP address assignment; setup programming for ACS building controllers; reader definitions; door alarm points.
 - 2. When the installation of all system components and cabling is complete, initial testing shall consist of local walk-through, and working demonstration of all features.
 - 3. All passwords or access codes for the system shall remain at factory default unless the factory default poses a security risk, in which case all passwords shall be communicated in writing to the FMP Lock Shop, and obtain written approval of such change. Any costs associated with password recovery shall be borne by the Contractor.
 - 4. The Owner shall be provided with a minimum of 2hrs training of the installed system after all startup and testing procedures have been completed and as-built documentation delivered.
 - a. Minimum hours of required training may increase based upon the system size and complexity.

- b. Training will include both an overview for building occupants and an in-depth session for FMP maintenance to a service level.
- 5. Prior to FMP Lock Shop final acceptance of the system all zones must be tested in the presence of designated representative(s) from FMP Lock Shop.

3.2 WORKSHOP

- A. The CONTRACTOR's organization shall conduct a workshop with the OWNER's representatives, ARCHITECT, and system vendor. Assume two 4-hour workshops are required.
- B. Prepare a detailed agenda and publish detailed minutes following.
- C. Workshop agenda topics shall include, at a minimum, the following:
 - 1. Functional requirements of the system.
 - 2. Existing equipment to be reused.
 - 3. Quantities/locations of field devices.
 - 4. Make/model of equipment.
 - 5. Door hardware and conduit interfaces.
 - 6. Power and raceway requirements.
 - 7. ADA door operator interface requirements (North Lobby basement).
 - 8. Facility lockdown initiation and reset.
 - 9. Interconnecting cabling/conduit.
 - 10. Testing.
 - 11. Training.
- D. Prior to the workshop, the CONTRACTOR, and its applicable subs shall undertake a comprehensive investigation of the material to be discussed.

3.3 INSTALLATION

- A. General.
 - 1. All identification labeling shall be in compliance with Section 260553, IDENTIFICATION FOR ELECTRICAL SYSTEMS.
 - 2. The CONTRACTOR shall coordinate the final locations, mounting heights, and requirements with the ARCHITECT and OWNER prior to installation.
 - 3. All programming and commissioning shall be provided by factory-trained personnel.
- B. Special Techniques
 - 1. Install system in accordance with manufacturer's instructions.
 - 2. Perform all work in accordance with acknowledged industry and professional standards.

- C. Systems Integration
 - 1. Develop, install, and test software and databases for the complete and proper operation of system involved. Assign software license to OWNER.
 - 2. The CONTRACTOR is responsible for the entire programming and setup of the system such that no additional programming is required. Programming shall include the setup of all available features of the software.
 - 3. Perform a full system back-up at completion of initial programming and deliver the configuration to the OWNER.
 - 4. Perform field software changes after the initial programming session to “fine tune” operating parameters and sequence of operations based on any revisions to the OWNER’s operating requirements.
- D. Demonstration
 - 1. Demonstrate the administration and operation of the devices as determined during the workshop.
 - 2. Demonstrate how to authorize users and applications to operate and configure installed devices.
 - 3. Demonstrate how an authorized user can gain access to and make changes to configuration.
 - 4. Demonstrate how to operate the functionality configured for this project as determined during the workshop.
- E. Training
 - 1. Provide the OWNER’s personnel access to the manufacturer’s training curriculum.
 - 2. Provide (2) 2-hour training sessions held on separate days to accommodate schedules of trainees.
- F. Final commissioning shall include a complete demonstration of the access control system to the OWNER. This shall include the following:
 - 1. Demonstrate that all access control door contacts and intrusion detection sensors operate correctly.
 - 2. Simulate alarm conditions at all doors, and demonstrate that an alarm signal is properly transmitted over Ethernet to the OWNER.
- G. Access Control Systems (ACS) Closeout, Warranty, and Support:
 - 1. With as-builts, record drawings, O&M manuals, etc. deliverables a complete list is required of all system devices, power packs, etc. noting their installed locations.
 - 2. Guarantee all work against faulty and improper material and workmanship for a minimum of 1 year from the date of final written acceptance by FMP Lock Shop, except where guarantee or warranties for longer terms are clearly requested and specified.
 - 3. During the entire warranty period the Contractor must provide all related software upgrades to the installed system(s).
 - 4. Upon notification of a problem, the warranty provider shall furnish within 48 hours at no cost to the Owner such labor and materials as are needed to restore the system to proper operation.
 - 5. During the entire warranty period the Contractor must guarantee a 4 hour response time for problem resolution.

6. Prior to the end of the warranty period, with FMP Lock Shop present, the Contractor is to conduct a 1year inspection repairing any item(s) at Contractor's cost and provide a report of system equipment and system operational functions.

3.4 AS-BUILT DRAWINGS

- A. As-built drawings shall be provided to the ENGINEER and OWNER in electronic (AutoCAD) and PDF format.

END OF SECTION

SECTION 321313

PORTLAND CEMENT CONCRETE

PART 1 – GENERAL

1.1 SUMMARY:

- A. Work Included: Provide Portland Cement concrete where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related Work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 QUALITY ASSURANCE:

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Concrete Standards: Comply with provisions of the following standards, except where more stringent requirements are indicated.
 - 1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
 - 2. ACI 318, "Building Code Requirements for Reinforced Concrete."
 - 3. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."

PART 2 - PRODUCTS

2.1 FORMS:

- A. Form Materials: Plywood, metal, metal-framed plywood, or other acceptable panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
 - 1. Use flexible or curved forms for curves of a 100-foot or less radius.
- B. Form Release Agent: Provide commercial formulation form-release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 REINFORCEMENT:

- A. Reinforcing Bars and Tie Bars: ASTM A 615, Grade 60, deformed.
- B. Plain, Cold-Drawn Steel Wire: ASTM A 82.
- C. Welded Steel Wire Fabric: ASTM A 185.
 - 1. Furnish in flat sheets, not rolls, unless otherwise acceptable to the Engineer.
- D. Deformed-Steel Welded Wire Fabric: ASTM A 497.
- E. Fabricated Bar Mats: Welded or clip-assembled steel bar mats, ASTM A 184. Use ASTM A 615, Grade 60 steel bars, unless otherwise indicated.
- F. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.
- G. Supports for Reinforcement: Chairs, spacers, dowel bar supports and other devices for spacing, supporting, and fastening reinforcing bars, welded wire fabric, and dowels in place. Use wire bar-type supports complying with CRSI specifications.
 - 1. Use supports with sand plates or horizontal runners where base material will not support chair legs.

- H. Fabricate reinforcement to the required shapes and dimensions, with fabrication tolerances complying with the CRSI "Manual of Standard Practices."
- I. Do Not Use Reinforcement Having Any of the Following Defects:
 - 1. Bar lengths, depths, or bends exceeding the specified fabricating tolerances;
 - 2. Bends or kinks not indicated on the Drawings or required for the Work;
 - 3. Bars with cross-section reduced due to excessive rust or other causes.

2.3 CONCRETE:

- A. Portland Cement: ASTM C 150, Type I.
 - 1. Use one brand of cement throughout Project unless otherwise acceptable to the Engineer.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4, and as follows: Provide aggregates from a single source.
 - 1. Maximum Aggregate Size: 1-1/2 inches.
 - 2. Do not use fine or coarse aggregates that contain substances that cause spalling.
 - 3. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to the Engineer.
- C. Water: Potable.
- D. Use only such additives as are recommended in the mix design and approved by the Engineer and governmental agencies having jurisdiction.
- E. Provide concrete in the proportions established by the mix design, and to the compressive strength shown on the Drawings.

2.4 CURING MATERIALS:

- A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
- B. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
 - 1. Waterproof paper.
 - 2. Polyethylene film.
 - 3. White burlap-polyethylene sheet.
- C. Clear Solvent-Borne Liquid Membrane-Forming Curing Compound: ASTM C 309, Type I, Class A or B, wax free.
- D. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.

2.5 CONCRETE MIX:

- A. Prepare design mixes for each type and strength of normal-weight concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use a qualified independent testing agency for preparing and reporting proposed mix designs.
- B. Proportion mixes according to ACI 211.1 and ACI 301 to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28-day): 3000 psi.
 - 2. Maximum Water-Cement Ratio at Point of Placement: 0.50.
 - 3. Slump Limit at Point of Placement: 5 inches.
 - a) Slump limit for concrete containing high-range water-reducing admixture (superplasticizer): Not more than 9 inches after adding admixture to site-verified 3-to-5-inch slump concrete.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows with a tolerance of plus or minus 1-1/2 percent:

1. Air Content: 3-5 percent.
 - D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, project conditions, weather, test results, or other circumstances warrant.
- 2.6 CONCRETE MIXING:**
- A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.
 1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- 2.7 OTHER MATERIALS:**
- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION:

- A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.
- B. Remove loose material from compacted subbase surface immediately before placing concrete.
- C. Notify the Engineer in writing of any unsatisfactory conditions. Do not begin paving work until these conditions have been satisfactorily corrected.

3.2 PLACEMENT OF BASE COURSE:

- A. Base:
 1. Spread the specified coarse aggregate to a thickness providing the compacted thickness shown on the Drawings.
 2. Compact to 95% maximum dry density according to ASTM D 1557.
- B. Thickness Tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of plus 1/2 inch, no minus.
- C. Smoothness Tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 1/2 inch vertically and 1 inch in alignment at any point.
- D. Correct deviations by removing materials, replacing with new materials, and reworking or recompacting as required.
- E. Use only the amount of moisture needed to achieve the specified compaction.

3.3 EDGE FORMS AND SCREED CONSTRUCTION:

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for paving to required lines, grades, and elevations. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.
- B. Check completed formwork and screeds for grade and alignment to the following tolerances:
 1. Top of Forms: not more than 1/8 inch in 10 feet.
 2. Vertical Face on Longitudinal Axis: Not more than 1/4 inch in 10 feet.
- C. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.

3.4 PLACING REINFORCEMENT:

- A. Comply with CRSI's recommended practice for "Placing Reinforcing Bars" for placing and supporting reinforcements.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire fabric in flat sheets in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities or replace units as required before placement. Set mats for a minimum 2 inch overlap to adjacent mats.

3.5 JOINTS:

- A. General: Construct contraction, construction, and isolation joints true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to the centerline, unless indicated otherwise.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints, unless indicated otherwise.
- B. Contraction Joints: Provide weakened-plane contraction joints, sectioning concrete into areas as shown on Drawings. Construct contraction joints for a depth equal to at least $\frac{1}{4}$ of the concrete thickness, as follows:
 - 1. Tooled joints: Form contraction joints in fresh concrete by grooving and finishing each edge of joint with a radiused jointer tool.
 - 2. Inserts: Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strips into fresh concrete until top surface of strip is flush with paving surface. Radius each joint edge with a jointer tool. Carefully remove strips or caps of two-piece assemblies after concrete has hardened. Clean groove of loose debris.
- C. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than $\frac{1}{2}$ hour, unless paving terminates at isolation joints.
 - 1. Continue reinforcement across construction joints unless indicated otherwise. Do not continue reinforcement through sides of strip paving unless indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.
- D. Isolation Joints: Form isolation joints of preformed joint filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 50 feet, unless indicated otherwise.
 - 2. Extend joint fillers full width and depth of joint, not less than $\frac{1}{2}$ inch or more than 1 inch below finished surface where joint sealant is indicated. Place top of joint filler flush with finished concrete surface when no joint sealant is required.
 - 3. Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.
 - 4. Protect top edge of joint filler during concrete placement with a metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- E. Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one half of dowel length to prevent concrete bonding to one side of joint.

3.6 CONCRETE PLACEMENT:

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcing before placing concrete. Do not place concrete on surfaces that are frozen.

- C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Comply with requirements and with ACI 304R for measuring, mixing, transporting, and placing concrete.
- E. Deposit and spread concrete in a continuous operation between transverse joints.
 - 1. Deposit concrete as nearly as practicable in its final location so as to avoid segregation due to rehandling and flowing.
 - 2. Do not push or drag concrete into place, use vibrators to move concrete or subject concrete to any procedure which will cause segregation.
 - 3. When concrete placing is interrupted for more than ½ hour, place a construction joint.
- F. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- G. Do not use concrete that has stood over 30 minutes after leaving the mixer, or concrete that is not placed within 60 minutes after water is introduced into the mix.
- H. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete complying with ACI 309R.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcing, dowels, and joint devices.
- I. Screed paved surfaces with a straightedge and strike off. Use bull floats or darbies to form a smooth surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces prior to beginning finishing operations.
- J. Curbs and Gutters: Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified.
- K. Slip-Form Pavers: Produce paving to required thickness, lines, grades, finish, and jointing as required for formed paving.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- L. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.
- M. Cold-Weather Placement: Comply with provisions of ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless specifically approved in writing by Engineer.
- N. Hot-Weather Placement: Place concrete complying with ACI 305R and as specified when hot weather conditions exist.
 - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F. Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.

3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 CONCRETE FINISHING:

- A. Float Finish: Begin floating when bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Finish surfaces to true planes within a tolerance of 1/4 inch to 10 feet as determined by a 10-foot-long straightedge placed anywhere on the surface in any direction. Cut down high spots and fill low spots. Refloat surface immediately to a uniform granular texture.
 1. Burlap Finish: Drag a seamless strip of damp burlap across concrete, perpendicular to line of traffic, to provide a uniform gritty texture finish.
 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristled broom across concrete surface perpendicular to line of traffic to provide a uniform fine line texture finish.
 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating surface 1/16 inch to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
- B. Final Tooling: Tool edges of paving, gutters, curbs, and joints formed in fresh concrete with a jointing tool to the following radius. Repeat tooling of edges and joints after applying surface finishes. Eliminate tool marks on concrete surfaces.
 1. Radius: ¼ inch.

3.8 CONCRETE PROTECTION AND CURING:

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with the recommendations of ACI 306R for cold weather protection and ACI 305R for hot weather protection during curing.
- B. Evaporation Control: In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before floating.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
 1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:
 - a) Water.
 - b) Continuous water-fog spray.
 - c) Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with a 12 inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.9 REPAIRS AND PROTECTION:

- A. Remove and replace concrete paving that is broken, damaged, or defective, or does not meet the requirements of this Section.
- B. Drill test cores where directed by the Engineer when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland Cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep concrete paving not more than 2 days prior to date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 48 00 01
PHOTOVOLTAIC SYSTEM DESIGN/BUILD PERFORMANCE

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. This Project consists of a design build contract for the Southern Oregon University Central Hall Building. This Specification Section includes work for the Electrical and the Photovoltaic Contractor and covers design/build performance requirements for the Photovoltaic Systems. The project shall include the following line items as part of the bid:
1. Field investigation to assess roof and array mounting types and existing conduit routing.
 2. Pitched roof mounted PV system (mounting hardware, solar panels, etc.)
 3. Flat roof rack mounted PV system (mounting hardware, solar panels, etc.)
 4. PV combiner panel and inverters located in Penthouse 301.
 5. Conductors between PV system and inverters in Penthouse 301 via existing conduit (2[2"C]).
 6. Conduit and conductors between inverters and PV combiner panel.
 7. Panel feeder from SE-1 to PV combiner panel in Penthouse 301 via existing conduit (2[2"C]).
 8. PV monitoring system.
- B. The Contractor shall provide complete design, provisions, installation, commissioning, and testing for a new 52 kWSTC (approximately) photovoltaic (PV) grid-tied roof-mounted system, as described herein. The system shall provide power to the structure.
- C. Obtain as-built documentation of the roof structure reflecting improvements made in a prior phase of work, designed by others. Verify that sloped roof system is suitably rated to support PV system in the areas identified on the plans.
- D. The work includes furnishing and/or paying for all materials, fees, and permits not covered in the general building permit, labor, tools, equipment, transportation, and services required for a complete installation.
- E. The Contractor shall include in the work, without additional cost to the Owner, any labor, materials, services, transportation, disposal, apparatus, or drawings needed in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on the Drawings or specified.

1.2 GENERAL

- A. Phasing: This Specification assumes that there will be a separate contractor to install the Photovoltaic System (if the electrical contractor has the appropriate qualifications, a photovoltaic contractor will not be necessary). The system shall be provided and installed in two phases. Phase 1 shall be completed by the electrical contractor, and shall include installation of conductors between the main electrical panel and the photovoltaic (PV) combiner panel location. Phase 2 shall be completed by the Photovoltaic Contractor and shall include installing the complete photovoltaic system, sloped and flat roof racking structure, PV modules, inverters, and interconnecting wiring back to combiner panel. Contractor, herein, refers to the Photovoltaic Contractor.
- B. The Contract Drawings show general equipment locations and sizes for some of the major PV system equipment. The Contractor shall comply with these criteria and include them in the Contractor design. The Contractor must obtain approval before altering any of the criteria set forth in these performance specifications or the architectural drawings.

1.3 COORDINATION AND PLANNING

- A. The Contractor shall coordinate with the Architect/Owner on the locations and appearance of all exposed equipment, including, but not limited to, PV modules, mounting structure, conduit, inverters, wireways, and control and monitoring equipment. All locations must be approved by the Architect/Owner before the Contractor's design drawings are completed and installation begins.
- B. The Contractor shall coordinate with the electrical contractor to provide the primary ac components of the system including, but not limited to, the PV backfeed subpanel, main service panel, and the conduit and wiring between these items as required for the system.
- C. The Contractor shall provide coordination with all trades needed for a complete installation including all required controls, electrical services, and clearances.

1.4 UTILITY APPROVAL

- A. Once the PV system design and drawings are completed and approved by the Engineer, and the Contractor has all required building and electrical permits, the Contractor shall file all required paperwork and forms with the serving utility to apply for interconnection with the utility grid, and to obtain approval in writing of the PV system.
- B. Upon receipt of final building inspection approval, Contractor shall immediately send a copy of the signed-off building permit to the electric utility and schedule the final utility inspection for the system. This inspection shall be scheduled for a date no later than 2 weeks after the date of final building inspection.

1.5 REQUIREMENTS

- A. The design shall include, but not be limited to, design drawings showing all ac and dc wiring associated with the system, conduit layout, details of equipment location, equipment selection, and Specifications. The equipment includes, but is not limited to, PV modules, inverters, disconnects, wire, conduit, junction boxes, mounting structure and hardware, monitoring equipment, and any other needed equipment.
- B. The Contractor shall provide access to equipment for maintenance and service as required by the manufacturer's instructions and/or applicable codes.
- C. The Contractor shall visit the site to ascertain the nature and location of the work and the general and local conditions that could affect the work or the cost thereof.
- D. The Contractor shall submit the design drawings and equipment specifications to the Engineer for approval before ordering equipment or beginning construction.

1.6 CODES, PERMITS, AND REGULATIONS

- A. The Contractor shall comply with all requirements of Division 26 05 10 and with the conditions of the Contract.
- B. Work shall comply with all applicable codes, standards, local authorities, utilities, and manufacturer's instructions/recommendations.
- C. The Contractor shall examine the architectural drawings to determine requirements.
- D. All work shall comply with the Building Department, Fire Department, and all other local Authorities Having Jurisdiction.
- E. All work, including equipment, materials, and installation shall conform to National Electric Code; and Uniform Fire Code, editions under jurisdiction.
- F. The requirement of the more-stringent code or standard shall govern where more than one code or standard is applicable to any component or condition.
- G. The Contractor shall obtain and comply with manufacturer specifications, instructions, and recommendations for all equipment and materials.

- H. The Contractor shall immediately notify the Engineer of any provision in the Specifications that is contrary to the applicable codes.
- I. Any work performed by the Contractor at variance with the applicable codes and without prior written approval of the Engineer shall be corrected as required without additional cost to the Owner.
- J. The Contractor shall give all necessary notices, obtain all permits, and pay all Government sales taxes, fees, and other costs, including utility connections or extensions, in connection with his work; file all necessary plans, prepare all documents, and obtain all necessary approvals of all Governmental Departments Having Jurisdiction; obtain all required certificates of inspection for his work, and deliver them to the Owner before request for acceptance and final payment for the work. Construction shall not begin until the proper permits have been obtained and are posted.

1.7 SUBMITTALS

- A. Drawings: The Contractor shall submit complete design calculations and drawings to the Engineer. Floor plans and roof plans will be provided to the Contractor by the Engineer. Contractor's drawing submittals shall show locations and sizes of all PV equipment, wiring, and conduit. These drawings shall include a one-line electrical diagram showing all dc and ac wiring and related electrical equipment in the PV system; an equipment layout drawing showing location of all PV equipment and conduit runs; a site plan showing the distances, if applicable, of PV system equipment from the nearest property lines and setback lines; details describing the exact PV module mounting strategy; equipment schedules for all major system components; and any items required by the Authorities Having Jurisdiction. PDF copies of the drawings and calculations shall be submitted for approval to the Engineer.
- B. Product Data: Submit PDF copies of the manufacturer's specifications for all equipment, accessories, and monitoring devices.
- C. Shop Drawings: Submit PDF copies of the shop drawings showing field connection details.
- D. Operation & Maintenance Manual: Submit PDF copies of the operation, installation, and maintenance manuals/instructions for all equipment. The complete manual shall provide operating and maintenance instructions for the system as a whole, performance curves, warranty information, approved shop drawings, recommended and complete parts lists, wiring diagrams, and all other bulletins and brochures pertinent to the operation and maintenance of equipment.
- E. As-Built Drawings: Submit two copies of the accurate as-built drawings and an electronic file AutoCAD (2013 or newer) after construction is complete.

1.8 SUBSTITUTIONS

- A. Manufacturers' names and equipment part numbers are used in the Specifications to establish a standard of quality and performance, as well as size parameters. These names and part numbers are not used to exclude other manufacturers, unless specifically noted. However, any substituted material shall be of equal quality and function, shall meet the established size requirements, and shall be submitted to the Engineer with complete performance data for approval prior to its acceptance and installation on the job.
- B. Any substituted material installed without the approval of the Engineer shall be removed and replaced with acceptable material at no cost to the Owner.
- C. Where the Contractor proposes to use an item of equipment other than that specified or detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring, or any other part of the mechanical, electrical, or architectural layout, all such redesign and all new drawings and detailing required therefore shall be prepared by the Contractor at his own expense and approved by the Architect.

- D. Where such approved deviation requires a different quantity and arrangement of piping, wiring, conduit, and equipment from that specified or indicated on the Drawings, the Contractor shall furnish and install any such piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system at no additional cost to the Owner.

1.9 SYSTEM OPERATION

- A. During the day, the PV modules convert sunlight to electricity. When the grid (i.e., utility power) is present, solar power output is used to run ac loads on site, and sell excess power to the grid (in this order of priority).
- B. Any electrical loads on during the day will be powered directly by solar power with any excess spinning the meter backwards and crediting the account.
- C. If the electrical load on site exceeds the solar output (as it will every night and during periods of rainy weather), then the serving utility supplies the balance seamlessly.
- D. If the utility grid fails, the solar output also ceases. No power is available until grid power returns. Batteries would be necessary to continue solar power when the grid is down.
- E. When utility power returns, the system automatically switches back to normal grid-intertie mode, and solar power resumes.

1.10 PHASE 1 DESIGN

- A. The Electrical Contractor shall provide and install conductors between the main electrical service panel (SE-1) location and the PV combiner panel. The conduit is existing, installed in a prior phase of work. Conduits were installed between roof and Penthouse 301, and between Penthouse 301 and SE-1. Field verify conduit locations and sizes, and pull new feeder conductors to serve PV system. The Contractor shall leave space in Penthouse 301 next to the conduits for future mounting of the PV system combiner panel and monitoring equipment. Coordinate with Phase 2 Contractor for timeline for termination of PV combiner panel feeder.
- B. The Electrical Contractor shall connect conductors to a supply side tap on SE-1 to serve the 200A PV combiner panel once installed.

1.11 PHASE 2 DESIGN

- A. The PV system shall include glazed PV modules arranged to suit the PV ready roof area. See architectural plans for PV ready roof area markup. B.
- B. Flat roof area also includes PV mounting points installed during a prior phase of work, to support three separate arrays:
 - 1. 48-feet long, 1-panel rack mounted array. (x2)
 - 2. 24-feet long, 1-panel rack mounted array.
- C. Sloped roof area PV modules shall be arranged uniformly in two rows, portrait orientation or three rows, landscape orientation. PV layout should maximize the designated PV area.
- D. PV system shall be equipped with Rapid Shutdown meeting the requirements of NEC 690.12.
- E. Inverters and combiner panel shall be located in Penthouse 301.
- F. Each series string of PV modules shall be independently protected by an isolation fuse or breaker before it is connected in parallel with the other string on that PV output circuit. The current rating of this isolation fuse or breaker shall be less than the derated ampacity of the wiring that it is protecting and greater than 1.56 times the short-circuit current rating of the PV modules in that PV source circuit. All other conductors and overcurrent devices shall be sized per the requirements of National Electric Code (NEC).
- G. Power Maximization: Contractor shall measure shading effects from nearby trees and use this information to determine the optimum grouping of series strings. Strings shall be grouped so

- that major shaded areas cover the least number of groups possible between the hours of 10:00 a.m. to 2:00 p.m. solar time. Engineering approval is required on final stringing plan.
- H. All roof wiring, inverters, and junction boxes shall be hidden from view beneath the modules.
 - I. The PV system shall include a device for monitoring and displaying the PV power and energy output.
 - J. All dc conductors shall be sized such that there is a maximum of 2% voltage drop measured at the short-circuit current rating of that circuit over the entire length of each circuit from PV: Module to inverter and back to PV module. All ac conductors shall be sized for a maximum of 2% voltage drop measured at the continuous ac current rating of the inverter between the inverter and the point of interconnection with the utility.
 - K. The Contractor shall provide the complete design and engineering for a permanent, weatherproof, roof-mounted structure for the PV array. The structure shall be constructed of structural steel or aluminum with concrete footings. The PV array shall be mounted flat to the south facing roof area. The Contractor shall provide all needed structural engineering for the structure. A pre-engineered system, such as Unirac or equal, may be used if approved by local authorities.
 - L. The PV array shall be located as shown on the Architectural Drawings. Verify and stake out the exact location with the Architect prior to installation.
 - M. Provide all equipment and connections for PV system monitoring, including a 5-year renewable subscription providing Web-based performance data on the PV system.
 - N. Grounding required.

1.12 CONTRACTOR

- A. The PV system described herein shall be built by a contractor licensed for solar system installation in the State of Oregon.

1.13 DAMAGE RESPONSIBILITY

- A. The Contractor shall be responsible for all damage from leaks or breaks in equipment, ductwork, pipes, or fixtures caused by Contractor's work on site during construction. The Contractor will also be responsible for all damages caused by leaks or breaks in new materials installed under this Specification for the duration of the warranty period.
- B. The Contractor shall correct any damage to utilities caused by the Contractor's work, and promptly make restitution for or proceed to repair and restore such damage to the satisfaction of the Owner at no additional cost to the Owner.

1.14 WARRANTY

- A. The Contractor shall warrant that the work conforms to Contract requirements and is free of any defects.
- B. The Contractor shall provide a minimum of a full 5-year warranty, or longer if required by the State rebate program in effect at the time of application, against breakdown or degradation of electrical output. The warranty shall cover all of the components of the generating system against breakdown or degradation in electrical output of more than 10% of their originally rated electrical output. The warranty shall cover the full parts and labor cost of repair or replacement of defective components or systems for a period of 5 years from the date of acceptance by the Owner, or longer if required by the State rebate program in effect at the time of application.
- C. Any defective materials or inferior workmanship during installation and/or the warranty period shall be corrected immediately to the entire satisfaction of the Engineer and without additional cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials, fixtures, and equipment required for the work shall be new, of first-class quality, and shall be furnished, delivered, installed, connected, and finished in every detail, and shall be selected and arranged as to fit properly into the building spaces.
- B. All equipment shall be listed and labeled per recognized electrical testing laboratory and installed per the listing requirements and the manufacturer's instructions.
- C. All equipment shall be properly grounded per the requirements of the National Electric Code, Article 250.

2.2 PV MODULES

- A. PV modules shall be IEEE 1262 compliant and listed to UL Standard 1703.
- B. Manufacturers, or equal:
 - 1. Silfab Solar Inc. SIL-500 HM.

2.3 PV COMBINER PANEL

- A. Combiner panel shall meet the requirements of Section, PANELBOARDS.

2.4 INVERTERS

- A. All inverters shall be IEEE 929 compliant, listed to UL Standard 1741, and approved by the electric utility before commissioning, testing, and operation of the system.
- B. Manufacturers, or equal:
 - 1. SolarEdge three-phase inverters.

2.5 MOUNTING HARDWARE

- A. Manufacturers, or equal:
 - 1. Unirac SolarMount.

2.6 MONITORING SYSTEM

- A. Manufacturers, or equal:
 - 1. SolarEdge monitoring platform, with a 5-year renewable subscription providing Web-based performance data on the PV system.

PART 3 EXECUTION

3.1 GENERAL

- A. All circuits connected to more than one source shall have overcurrent devices located so as to provide overcurrent protection from all sources per NEC Article 690-9 (a).
- B. Photovoltaic system shall be interconnected with the utility grid per the requirements of NEC 705, using a supply side connection.
- C. Cut no structural members. If equipment cannot be properly concealed, notify Architect. Any patching and cutting done as a result of error or neglect on the part of the Contractor shall be corrected at no expense to the Owner.
- D. Attachments: Support all work adequately and per code. All equipment shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature.
- E. Shoring: The Contractor shall provide all permanent and temporary shoring, anchoring, and bracing required by the nature of this work in order to make all parts absolutely stable and rigid, even when such shoring, anchoring, and bracing are not explicitly called for.

- F. Labeling: Labels per NEC Article 690 and Article 705 shall be provided. The PV backfeed subpanel, and all breakers contained in it, and the PV system disconnect shall be clearly labeled.
- G. Training: The Contractor shall be responsible for proper instruction of the Owner's personnel regarding operation and maintenance of equipment and apparatus installed as specified in this Section.
- H. Contractor shall keep work areas in a clean and safe condition. Remove all equipment, tools, vehicles, rubbish, waste, and debris from the site upon completion of the job. The Contractor shall pay all fees for recycling and disposal.

3.2 TESTING AND INSPECTIONS

- A. The Contractor shall notify the Owner a minimum of 5 days before closing in of to-be-concealed work so that an Owner's representative may inspect the work.
- B. Before starting or operating the system, Contractor shall check continuity of all conductors and grounding conductors to verify that there are no faults and that all equipment has been properly installed. Check factory instructions to see that installations have been made accordingly. Check equipment for any damage that may have occurred during shipment, after delivery, or during installation. Repair damaged equipment or replace with new equipment of like kind.
- C. Before starting or operating the system, Contractor shall obtain a final inspection approval from the Building Department and a final inspection approval from the utility. Contractor shall be present on site for both of these inspections.
- D. Once Building Department and the utility final approvals have been received, Contractor shall test all equipment to ensure specified capacity and performance of the system. The Contractor shall notify the Owner a minimum of 5 working days prior to the test so that an Owner's representative may witness the test. Contractor shall replace or revise any equipment, systems, or work found deficient during the test.
- E. Contractor shall make final adjustments to all inverters and monitoring equipment so that they will be placed in an acceptable operating condition. Adjustable parameters shall be set so that the PV system will produce the maximum possible amount of energy on an annual basis.

END OF SECTION