# TABLE OF CONTENTS

PERMIT NOTICE
INVITATION TO BID
INSTRUCTION TO BIDDERS
BID FORM
BID PACKAGES
GENERAL REQUIREMENTS AND SPECIFICATIONS
SCHEDULE
SAMPLE ENVELOPE AND LABEL
MONTANA PREVAILING WAGE RATES

## DIVISION 01 - GENERAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 1000</td>
<td>SUMMARY</td>
</tr>
<tr>
<td>01 2000</td>
<td>PRICE AND PAYMENT PROCEDURES</td>
</tr>
<tr>
<td>01 2300</td>
<td>ALTERNATES</td>
</tr>
<tr>
<td>01 3000</td>
<td>ADMINISTRATIVE REQUIREMENTS</td>
</tr>
<tr>
<td>01 3610</td>
<td>SUSTAINABLE DESIGN REQUIREMENTS - LEED FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS</td>
</tr>
<tr>
<td>01 4000</td>
<td>QUALITY REQUIREMENTS</td>
</tr>
<tr>
<td>01 5000</td>
<td>TEMPORARY FACILITIES AND CONTROLS</td>
</tr>
<tr>
<td>01 5500</td>
<td>VEHICULAR ACCESS AND PARKING</td>
</tr>
<tr>
<td>01 5713</td>
<td>TEMPORARY EROSION AND SEDIMENT CONTROL</td>
</tr>
<tr>
<td>01 6000</td>
<td>PRODUCT REQUIREMENTS</td>
</tr>
<tr>
<td>01 6116</td>
<td>VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS</td>
</tr>
<tr>
<td>01 7000</td>
<td>EXECUTION AND CLOSEOUT REQUIREMENTS</td>
</tr>
<tr>
<td>01 7419</td>
<td>CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL</td>
</tr>
<tr>
<td>01 7800</td>
<td>CLOSEOUT SUBMITTALS</td>
</tr>
<tr>
<td>01 7900</td>
<td>DEMONSTRATION AND TRAINING</td>
</tr>
<tr>
<td>01 9113</td>
<td>GENERAL COMMISSIONING REQUIREMENTS</td>
</tr>
<tr>
<td>01 9114</td>
<td>COMMISSIONING AUTHORITY RESPONSIBILITIES</td>
</tr>
</tbody>
</table>

## DIVISION 02 - EXISTING CONDITIONS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>02 4100</td>
<td>DEMOLITION</td>
</tr>
</tbody>
</table>

## DIVISION 03 - CONCRETE

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>03 1119</td>
<td>INSULATING CONCRETE FORMS</td>
</tr>
<tr>
<td>03 3000</td>
<td>CAST-IN-PLACE CONCRETE</td>
</tr>
<tr>
<td>03 3511</td>
<td>CONCRETE FLOOR FINISHES</td>
</tr>
</tbody>
</table>

## DIVISION 04 - MASONRY

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>04 2001</td>
<td>MASONRY VENEER</td>
</tr>
</tbody>
</table>

## DIVISION 05 - METALS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>05 1200</td>
<td>STRUCTURAL STEEL</td>
</tr>
<tr>
<td>05 2100</td>
<td>STEEL JOIST FRAMING</td>
</tr>
<tr>
<td>05 3100</td>
<td>STEEL DECKING</td>
</tr>
<tr>
<td>05 4000</td>
<td>COLD-FORMED METAL FRAMING</td>
</tr>
<tr>
<td>05 5000</td>
<td>METAL FABRICATIONS</td>
</tr>
<tr>
<td>05 5100</td>
<td>METAL STAIRS</td>
</tr>
</tbody>
</table>
PIPE AND TUBE RAILINGS
GRATINGS AND FLOOR PLATES

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES
ROUGH CARPENTRY
ARCHITECTURAL WOOD CASEWORK

DIVISION 07 - THERMAL AND MOISTURE PROTECTION
SHEET WATERPROOFING
THERMAL INSULATION
WEATHER BARRIERS
METAL WALL PANELS
PVC THERMOPLASTIC SINGLE-PLY ROOFING
SHEET METAL FLASHING AND TRIM
ROOF SPECIALTIES
ROOF ACCESSORIES
JOINT SEALANTS
EXPANSION JOINT COVER ASSEMBLIES

DIVISION 08 - OPENINGS
HOLLOW METAL DOORS AND FRAMES
OVERHEAD COILING DOORS
SECTIONAL DOORS
GLAZED ALUMINUM CURTAIN WALLS
ALUMINUM WINDOWS
DOOR HARDWARE
GLAZING

DIVISION 09 - FINISHES
GYPSUM BOARD ASSEMBLIES
SUSPENDED ACOUSTICAL CEILINGS
RESILIENT FLOORING
TILE CARPETING
EXTERIOR PAINTING
INTERIOR PAINTING

DIVISION 10 - SPECIALTIES
SIGNAGE
WIRE MESH PARTITIONS
FIRE PROTECTION SPECIALTIES

DIVISION 11 - EQUIPMENT
LOADING DOCK LEVELERS

DIVISION 14 - CONVEYING EQUIPMENT
VERTICAL RECIPROCATING CONVEYOR
DIVISION 21 – FIRE SUPPRESSION
21 0517 SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING
21 0518 ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING
21 0553 IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
21 1313 WET-PIPE SPRINKLER SYSTEMS
21 1316 DRY-PIPE SPRINKLER SYSTEMS

DIVISION 22 – PLUMBING
22 0000 PLUMBING GENERAL REQUIREMENTS
22 0517 SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING
22 0518 ESCUTCHEONS FOR PLUMBING PIPING
22 0523 GENERAL-DUTY VALVES FOR PLUMBING PIPING
22 0529 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
22 0548 VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
22 0553 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
22 0719 PLUMBING PIPING INSULATION
22 1116 DOMESTIC WATER PIPING
22 1316 SANITARY WASTE AND VENT PIPING
22 1413 FACILITY STORM DRAINAGE PIPING
22 3300 ELECTRIC, DOMESTIC-WATER HEATERS
22 4100 PLUMBING FIXTURES

DIVISION 23 – HEATING VENTILATION AND AIR CONDITIONING
23 0000 MECHANICAL GENERAL REQUIREMENTS
23 0516 EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING
23 0517 SLEEVES AND SLEEVE SEALS FOR HVAC PIPING
23 0519 METERS AND GAGES FOR HVAC PIPING
23 0520 BTU METERS
23 0523 GENERAL-DUTY VALVES FOR HVAC PIPING
23 0529 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
23 0548 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
23 0553 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
23 0593 TESTING, ADJUSTING, AND BALANCING FOR HVAC
23 0713 DUCT INSULATION
23 0719 HVAC PIPING INSULATION
23 0900 INSTRUMENTATION AND CONTROL FOR HVAC
23 0993 SEQUENCE OF OPERATIONS FOR HVAC CONTROLS
23 2113 HYDRONIC PIPING
23 2123 HYDRONIC PUMPS
23 3113 METAL DUCTS
23 3300 AIR DUCT ACCESSORIES
23 3713 DIFFUSERS, REGISTERS, AND GRILLES
23 7200 AIR-TO-AIR ENERGY RECOVERY EQUIPMENT
23 8123 PRECISION HVAC UNITS
23 8127 VRF HEAT PUMP SYSTEMS

DIVISION 26 – ELECTRICAL
26 0519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 0526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 0529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
26 0533 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
26 0548 VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

TABLE OF CONTENTS
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 0553</td>
<td>IDENTIFICATION FOR ELECTRICAL SYSTEMS</td>
</tr>
<tr>
<td>26 0923</td>
<td>LIGHTING CONTROL DEVICES</td>
</tr>
<tr>
<td>26 2413</td>
<td>DISCONNECT METER CABINET</td>
</tr>
<tr>
<td>26 2416</td>
<td>PANELBOARDS</td>
</tr>
<tr>
<td>26 2726</td>
<td>WIRING DEVICES</td>
</tr>
<tr>
<td>26 2813</td>
<td>FUSES</td>
</tr>
<tr>
<td>26 2816</td>
<td>ENCLOSED SWITCHES AND CIRCUIT BREAKERS</td>
</tr>
<tr>
<td>26 5100</td>
<td>LIGHTING</td>
</tr>
<tr>
<td>26 5119</td>
<td>LED INTERIOR LIGHTING</td>
</tr>
</tbody>
</table>

**DIVISION 27 – COMMUNICATIONS**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>27 0528</td>
<td>PATHWAYS FOR COMMUNICATIONS SYSTEMS</td>
</tr>
<tr>
<td>27 0544</td>
<td>SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLES</td>
</tr>
<tr>
<td>27 1100</td>
<td>COMMUNICATIONS EQUIPMENT ROOM FITTING</td>
</tr>
<tr>
<td>27 1300</td>
<td>COMMUNICATIONS BACKBONE CABLING</td>
</tr>
<tr>
<td>27 1500</td>
<td>COMMUNICATIONS HORIZONTAL CABLING</td>
</tr>
</tbody>
</table>

**DIVISION 28 – ELECTRONIC SAFETY AND SECURITY**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 3111</td>
<td>DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM</td>
</tr>
</tbody>
</table>

**DIVISION 31 – EARTHWORK**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 1000</td>
<td>SITE CLEARING</td>
</tr>
<tr>
<td>31 2200</td>
<td>GRADING</td>
</tr>
<tr>
<td>31 2316</td>
<td>EXCAVATION</td>
</tr>
<tr>
<td>31 2316.13</td>
<td>TRENCHING</td>
</tr>
<tr>
<td>31 2323</td>
<td>FILL</td>
</tr>
</tbody>
</table>

**DIVISION 32 – EXTERIOR IMPROVEMENTS**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 1216</td>
<td>ASPHALT PAVING</td>
</tr>
<tr>
<td>32 1313</td>
<td>CONCRETE PAVING</td>
</tr>
<tr>
<td>32 9219</td>
<td>SEEDING</td>
</tr>
</tbody>
</table>
PERMIT NOTICE

The Contractor will be responsible for paying the city of Bozeman Building Inspection Division for building, electrical, mechanical, and plumbing permits.

The Owner will be responsible for paying the city of Bozeman plan review fee and impact fees.

CITY OF BOZEMAN
BUILDING INSPECTION DIVISION
20 EAST OLIVE STREET
SUITE 208
BOZEMAN, MONTANA 59715
(406) 582-2375
INVITATION TO BID

*Museum of the Rockies Collections & Storage Facility*

*Bid Schedule #1*

*Museum of the Rockies*

*Bozeman, MT*

**TABLE OF CONTENTS:**

1. Project Overview
2. Instruction to Bidders
3. Bid Form
   - Bidders Checklist
   - Insurance Requirements
4. Bid Packages
5. General Requirements & Specifications
6. Schedule
7. Sample Envelope & Label

**BIDS ARE DUE AS FOLLOWS:**

**PLACE:**
Montana State University
Campus Planning, Design, & Construction
Plew Building
6th and Grant
PO Box 172760
Bozeman, MT
Fax: 406-994-5665
Phone: 406-994-5413

**DATE:** June 21, 2016

**TIME:** 2:00 PM
1. PROJECT OVERVIEW:

We are pleased to offer you the opportunity to propose upon Museum of the Rockies Collections & Storage Facility. Please carefully read the included invitation to bid and scope of work definitions.

Museum of the Rockies Collections & Storage Facility will include the following Bid Package Items:

1.2A – Supply/Install Sitework and Utilities
1.2B – Supply/Install Selective Building Demolition
1.3A – Supply/Install Concrete
1.3B – Supply/Install Insulating Concrete Formwork and Building Footings
1.4A – Supply/Install Masonry
1.5A – Supply Structural Steel
1.5B – Install Structural Steel
1.5C – Supply/Install Structural Steel
1.5D – Supply/Install Metal Stud Framing
1.6A – Supply/Install Rough Carpentry
1.7A – Supply/Install Insulation
1.7B – Supply/Install Siding
1.7C – Supply/Install Roofing
1.8A – Supply/Install Doors, Frame & Hardware
1.8B – Supply/Install Overhead Coiling and Sectional Doors
1.8C – Supply/Install Glazing and Windows
1.9A – Supply/Install Drywall
1.9B – Supply/Install Flooring
1.9C – Supply/Install Paint
1.9D – Supply/Install Acoustical Suspended Ceilings
1.10A – Supply/Install Specialties
1.11A – Supply/Install Loading Dock Leveler
1.14A – Supply/Install Vertical Reciprocating Conveyor
1.21A – Supply/Install Fire Suppression Systems
1.22A – Supply/Install Plumbing Systems, Mechanical Piping, and HVAC
1.26A – Supply/Install Electrical and Fire Alarm Systems
Please Note:

- The bid date and time of June 21, 2016 at 2:00PM is firm.
- This project is a prevailing wage project.
- Bids are to be delivered to Campus Planning, Design and Construction Office of Montana State University in Bozeman, MT via fax, mail, or hand delivered by no later than the bid date and time outlined above. There will be a public bid opening at that time. Upon review and acceptance by the CM/GC and Montana State University, bid results will be forwarded to all bidders. It is preferred that bids are delivered by hand.
- Bid Bonds are not required.

Project Team

Owner
Montana State University
PO Box 172760
Bozeman, MT 59717
Tele: 406-994-5413
Mr. William Walker, Project Manager

General Contractor / Construction Manager
Jackson Contractor Group, Inc. (JCG)
PO Box 6581
Bozeman, Montana 59771
Tele: 406-577-2772 | Fax: 406-587-4282
Mr. Nick Van Tighem, Project Manager

Architect of Record
Slate Architecture
107 West Lawrence Street
Helena, MT 59601
Tele: 406-457-0360
Mr. Jacob Augustein, Project Architect
2. INSTRUCTIONS TO BIDDERS:

2.1 DOCUMENTS

The Contract Documents may be viewed at the following locations:

Builders Exchange of Billings  
2050 Broadwater ST E A  
Billings MT 59102 Voice: (406) 652-1311 Fax: (406) 652-1391

Bozeman Builders Exchange  
1105 Reeves RD W STE 800  
Bozeman MT 59718 Voice: (406) 586-7653 Fax: (406) 586-4062

Butte Builders Exchange  
305 W Mercury STE 401  
PO BOX 4136  
Butte MT 59701 (auto switch) Voice: (406) 782-5433 Fax: (406) 782-5433

Great Falls Builders Exchange  
202 2ND Avenue S  
Great Falls MT 59401 Voice: (406) 453-2513 Fax: (406) 727-7548

Missoula Plans Exchange  
201 N Russell ST (59801)  
PO BOX 3109  
Missoula MT 59806 Voice: (406) 549-5002 Fax: (406) 721-2941

2.2 CODE OF CONDUCT POLICY

All on-site workers will be required to sign and adhere to a code of conduct prior to being allowed access to the site.

2.3 JOBWALK

At the request of the owner the project site is not accessible to bidders except during scheduled job-walks. A non-mandatory job walk is scheduled for June 8, 2016 at 10:00AM. Questions during each job walk will be recorded and distributed to all bidders. The project site is located at Museum of the Rockies Bozeman, Montana. The project address is 600 W Kagy Blvd Bozeman, MT 59717. Please meet at the main entrance

2.4 EXAMINATION OF DOCUMENTS, SITE, AND LOCAL CONDITIONS

Carefully examine the Bid Documents. Requests for payment for additional costs relative to conditions reasonably determinable by examination of the Bid Documents, site location and existing site conditions will not be considered.

Each Bidder, by submitting a bid, represents that:

- They have read and understand the Bid Documents and have verified local conditions under which the work is to be performed.
- Their bid is made in accordance with the Bid Documents and is based upon the materials, systems, and equipment described without exception.
Contractors and any subcontractors doing work on this project will require registration with the Montana Department of Labor and Industry. Forms for registration are available from the Department of Labor and Industry, P.O. Box 8011, 1805 Prospect Avenue, Helena, Montana 59604-8011. Information on registration can be obtained by calling 1-800-556-6694. Contractors are required to have been registered with the Department of Labor and Industry prior to bidding on this project.

2.5 INTERPRETATIONS DURING BIDDING

Submit all questions to Jackson Contractor Group, Inc., ATTN: Nick Van Tighem, in writing as soon as possible but no later than five (5) working days before the bid due date. Phone questions will not be accepted. nickv@jacksoncontractorgroup.com

2.6 DISCREPANCIES

The Bidder shall notify Jackson Contractor Group, Inc. in writing prior to the bid date of discrepancies, errors, and/or omissions that have been found in the Drawings and/or Specifications. If an explanation is necessary, a reply will be made via an Addendum issued to all Bidders.

2.7 ADDENDA

Jackson Contractor Group, Inc. may, during the bidding period, advise the Bidders by addenda of additions, omissions, or alterations in the Specifications and/or Drawings. All such changes shall be included in the Scope of Work covered by the proposal and shall become a part of the Drawings and Specifications as if originally included.

2.8 PERFORMANCE AND PAYMENT BOND

The successful Bidder, if requested, shall deliver all required bonds to the Construction Manager no later than the date of execution of the Subcontract. Failure to or negligence in delivering said bonds as specified shall be considered as having abandoned the Subcontract.

2.9 DISQUALIFICATION OF BIDDERS

The right is reserved to reject any or all Bids received, to waive irregularities, to make an award of the contract for a period of not to exceed sixty (60) days, and to accept the most responsive and responsible bid which is in the best interest of the Museum of the Rockies project.

2.10 SCHEDULE

By submitting a bid, the Bidder represents that he/she agrees to the terms of the project schedule, which is included, and has included all provisions necessary to accomplish all work within this schedule. The schedule furnished has been prepared to indicate the anticipated periods available for the execution of the work. The Bidder is responsible for completing specified activities in the timeframes/durations indicated.

➤ Anticipated Award Date: 6/24/2016
2.11 MODIFICATION OR WITHDRAWAL OF BID

Bids may not be modified after submittal. Bidders may withdraw bids at any time before bid opening, but may not re-submit them. Bids will remain good for a period of not less than sixty (60) days from date of submission.

2.12 EXECUTION OF CONTRACT

Bidders shall understand and accept the sample subcontract attached to this bid form to acknowledge review and acceptance of agreement form. Executing the sample subcontract does not constitute an agreement between Bidder and JCG. The execution of the sample contract is to acknowledge the Bidder has reviewed and is aware of the subcontract terms and conditions.

2.13 SUBMITTALS

Upon notification by JCG of acceptance of your bid you must have full and complete submittals in our office not later than (14) fourteen calendar days after award or as specified in the specific scope of work. Delays associated with the failure to meet this duration will be recorded as to their effects on the overall schedule and outcome of the project.

2.14 BID FORMS

If a bidder chooses to bid more than one bid package, they must fill out a separate bid form for each bid package. Bids must be received in a sealed envelope with the bid package number clearly marked on the front of the envelope. See attached bid envelope label. Bids with no bid package indication will not be opened. In order for a bid to be considered responsive must be on the supplied bid form. BIDS THAT ARE NOT ON THE SUPPLIED BID FORM MAY NOT BE READ. THE GC/CM AND OWNER RESERVE THE OPTION TO HAVE THE BID BE CONSIDERED NON-RESPONSIVE.

2.15 ALTERNATES

The bid form includes itemized alternates for the completion of items from Schedule A. The bidder is to include pricing for each alternate item to provide all labor, materials, and equipment necessary to complete the identified work in the scope of the bid package for which a price is being submitted (e.g. the site work contractor will perform all site work related to the alternate, the concrete contractor will perform all concrete work related to the alternate, etc.). It is imperative that the bidder attends the pre-bid conference to identify this work in its entirety.

2.16 PROPOSAL ACCEPTANCE/BASIS FOR SELECTION

The owner and construction manager reserve the right to reject any or all proposals. Any award will be made to the bidder whose proposal and qualifications indicate that the award will be in the best interest of the Project Team.

The owner and construction manager reserve the right to waive informalities in bids submitted and to hold and consider as many bids as they so desire for a period of sixty (60) days after the bids are opened.

All responsive proposals may be selected to receive an interview with the Project Team to discuss the firm’s experience, current workload, ability to perform, and value-engineering
items included with the bid. No award will be made until the Project Team has concluded such investigations as deemed necessary and appropriate to establish the responsibility, qualifications, and financial capability of the bidder to do the work in accordance with the contract, to the satisfaction of the CM/GC and within the time prescribed. Investigation of a bidder may continue after bids have been submitted. The final award and selection will be made after interviews & investigations are complete, a complete evaluation of the price, value engineering and ability to perform
3. Bid Form

Museum of the Rockies Collections & Storage Facility
Bozeman, MT

BID FORM

BID PACKAGE: ____________________________________________________________

Submitted By: _____________________________________________________________

To: Jackson Contractor Group c/o Montana State University
   Campus Planning, Design, and Construction
   Plew Building
   Bozeman, MT 59717

On Behalf of:
Museum of the Rockies Collections & Storage Facility
Bozeman, MT

We, the undersigned Company, having carefully read the Documents for the proposed contract, including the General Conditions, Supplemental Conditions, Specifications, and Drawings and Addendums and having carefully ascertained the conditions under which the Work is to be performed, hereby propose and offer to enter into a Contract to perform the Work as described in accordance with the Documents, complete and ready for use by the time specified, for the price of:

Base Bid (Including 1% GRT):

Museum of the Rockies Collections & Storage Facility
Complete as per Bid Package named above $____________________________

Alternate #1 – Casework
Complete as per Bid Package named above $____________________________

Bond (if required) $____________________________
Cost to Supply 100% Performance and Payment Bond

The bidder may attach a proposal detailing any specific inclusions or exclusions intended with the submitted pricing.
PERIOD OF ACCEPTANCE:
The proposer agrees that this bid shall remain open for acceptance and the price shall remain unchanged and notwithstanding any error in the Bid at the amount stated for a period of sixty (60) days from the date of closing of this Proposal.

CONTRACT:
The Bidder agrees that this Bid is subject to a formal subcontract being prepared and executed with the Construction Manager.

The Bidder agrees to execute the Contract within 14 days of notification of the acceptance of his bid and to provide Certificates of Insurance including Worker’s Compensation Insurance.

The Bidder shall furnish 100 % performance and Payment Bonds, if required by the Construction Manager. Cost of said bonds is listed as a bid item to the base bid above.

ADDENDA:
Addendum No. 1: ______________________________
Addendum No. 2: ______________________________
Addendum No. 3: ______________________________

ADDITIONAL INFORMATION MAY BE REQUESTED AFTER BID PROPOSALS ARE OPENED

1. References of Similar Projects – Minimum of 3
   Owner, Contractor and Architect
2. Staffing and Organizational Chart for this Project
3. Letter from Surety supporting ability to bond
4. Current Insurance Limits
5. Current Work Load
6. Potential Interview

SUBMITTED BY:
Company: _______________________________________
Name of Bidder: _____________________________________
Signature of Bidder: ___________________________________
Dated: _____________________________________________
Registration No.: _____________________________________
Phone No: ___________________________________________
Fax No: _____________________________________________
Email: _____________________________________________
CONDITIONS OF BID:
By submitting this bid, the bidder agrees to the following. Please initial the line in front of each statement.

1. The bidder has visited the site of the Project, has fully examined, and considered the existing conditions affecting the work. JCG/Owner will not accept Change Order Requests as a result of the Subcontractor’s failure to have made a pre-bid examination of the existing conditions.

2. The bidder has reviewed the JCG insurance requirements and can meet or exceed all of the requirements. If subcontractor cannot meet the requirements they must indicate so on the following checklist.

3. The bidder has reviewed the attached Project Schedule and agrees to meet the durations as shown, unless bidder has noted otherwise.

4. The bidder has reviewed the Specific Scope of Work and agrees to meet all terms and conditions as required.

5. The bidder has reviewed the Sample JCG Contract and agrees to meet all terms and conditions, without alteration.

6. The bidder fully understands the site lay down, storage, parking and work area limitations of this project. All accommodations must be considered when proposing as space will not be available on site for these items.

7. The bidder understands that all offloading and hoisting of materials, manpower and equipment is the sole responsibility of the subcontractor

8. The bidder understands the LEED requirements of the project and how those requirements will affect their specific scope of work and responsibilities

Jackson Contractor Group reserves the right to reject any or all proposals. Any award will be made to the bidder whose proposal and qualifications indicate that the award will be in the best interest of the Project Team.

Jackson Contractor Group reserves the right to waive informalities in bids submitted and to hold and consider as many bids as they so desire for a period of sixty (60) days after the bids are opened.

All responsive proposals may be selected to receive an interview with the Project Team to discuss the firm's experience, current workload, ability to perform, and value-engineering items included with the bid. No award will be made until the Project Team has concluded such investigations as deemed necessary and appropriate to establish the responsibility, qualifications, and financial capability of the bidder to do the work in accordance with the contract, to the satisfaction of the CM/GC and within the time prescribed. Investigation of a bidder may continue after bids have been submitted. The final award and selection will be made after interviews & investigations are complete, and a complete evaluation of the price, value engineering and ability to perform.
INSURANCE REQUIREMENTS:

The Subcontractor agrees to follow all current applicable Occupational Safety & Health Administration (OSHA) Standards. In the event that the Subcontractor is cited for OSHA standard violations, any and all penalties levied against the contractor due to the actions of the Subcontractor, will be deducted by the Contractor from the Subcontracts contract amount.

The Subcontractor shall procure and maintain in force with companies acceptable to the Construction Manager, insurance with limits of liability of not less than the following:

1. Workers Compensation Statutory
2. Employers Liability $1,000,000.00 (Per Occurrence)
3. Commercial General Liability Including Completed Operations, Contractual & Aggregate Limit
   - Per Project
     - Bodily Injury & Property Damage $1,000,000.00 (Per Occurrence)
     - Personal Injury $1,000,000.00 (Per Occurrence)
     - General Aggregate $2,000,000.00 (Per Occurrence)
     - Products & Completed Operations Aggregate $2,000,000.00 (Per Occurrence)
4. Commercial Auto Liability $1,000,000.00 (Each Accident)
   - Bodily Injury & Property Damage - Combined Single Limit Including Non-Owned & Hired Auto
5. The **Construction Manager and Owner shall be named as additional insured** on each of these policies except for Workers Compensation and Employers Liability. The Subcontractor shall be primary to any and all other insurance with respect to any and all claims and demands made against Contractor or Owner.

The Subcontractor must keep and maintain complete operational coverage that meets or exceeds the minimum coverage stated above for the entire construction period and for at least 1 year post substantial competition or for a minimum of three years from date of subcontract.

All insurance policies shall contain a provision that coverage afforded under the policies will not be cancelled, not renewed, or materially altered until at least thirty (30) days prior written notice has been given to the Contractor. Certificates of Insurance showing coverage to be in force shall be on file with the Contractor **prior** to the commencement of the Subcontractors Services.
Indemnification:

To the fullest extent permitted by law, it is expressly agreed and understood that the Subcontractor shall indemnify, defend, and hold harmless contractor, (including its owners, affiliates and subsidiaries), its officers, directors, agents, shareholders, successors and employees from and against any and all claims liabilities, actions cause of actions complaints, laws, expenses (including prejudgment interest) , and demands whatsoever in law and in equity including without limitations those of bodily injury, personal injury, sickness, disease, death, or property damage, (including but not limited to the work itself), arising out of, or alleged to arise out of or as a result of, or alleged as a result of, or to arise out of, the performance of the Subcontractor's work under this Subcontract Agreement, Subcontractor, at Subcontractors sole expense, shall promptly dispose of all such claims, defend all lawsuits against contractor, on the account hero, pay all judgments rendered against Contractor on the account thereof including, but not limited to, attorney fees, expert witness fees and court costs. It is expressly agreed and understood by Subcontractor that Subcontractor shall indemnify Contractor and hold Contractor harmless from the above referenced claims regardless of whether such claim is caused or alleged to be caused in part by joint or concurrent negligent act (either active or passive) or omission by a party indemnified hereunder provided however, the Subcontract shall not be obligated to indemnity for those claims which arise from the sole negligence or willful misconduct of the Contractor or the Contractors agents, servants or independent Contractors who are directly responsible to the Contractors excluding Subcontractor herein.

END OF BID FORM
Museum of the Rockies Collections & Storage Facility
Bozeman, MT

4. Bid Packages

See attached Bid Package Outline & Descriptions
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2A</td>
<td>Sitework, Excavation, &amp; Utilities - Complete</td>
<td>This package <em>shall include</em> all required materials, labor and equipment necessary to Complete <strong>Sitework, Excavation &amp; Utilities</strong> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td><strong>Sitework, Excavation, &amp; Utilities - Complete</strong></td>
</tr>
<tr>
<td></td>
<td>• 01 5713 – Temporary Erosion and Sediment Control</td>
<td>• Coordination with the Concrete Subcontractor for foundation excavations and site concrete</td>
</tr>
<tr>
<td></td>
<td>• 02 4100 - Demolition</td>
<td>• All construction staking required to complete this scope of work including utilities, excavation and grading limits, paving limits, and bluetopping for pavement.</td>
</tr>
<tr>
<td></td>
<td>• 31 1000 – Site Clearing</td>
<td>• Demolish all site elements required by plans and specifications or to accomplish new work</td>
</tr>
<tr>
<td></td>
<td>• 31 2200 – Grading</td>
<td>• All SWPPP plans, permits, erosion and sedimentation control measures, maintenance of said control measures, and reporting</td>
</tr>
<tr>
<td></td>
<td>• 31 2316 – Excavation</td>
<td>• All excavation, piping, &amp; grading for storm drain piping, runoff, retention basins, precast structures and swales</td>
</tr>
<tr>
<td></td>
<td>• 31 2316.13 - Trenching</td>
<td>• 20” diameter steel casing per C2</td>
</tr>
<tr>
<td></td>
<td>• 31 2323 – Fill</td>
<td>• Stormtech underground storm water storage chambers</td>
</tr>
<tr>
<td></td>
<td>• 32 1216 – Asphalt Paving</td>
<td>• All permits required to complete this bid package are the responsibility of this subcontractor</td>
</tr>
<tr>
<td></td>
<td>• 32 9219 - Seeding</td>
<td>• Furnish and install all woven geotextile fabrics as required by contract documents</td>
</tr>
<tr>
<td></td>
<td>• MPWSS</td>
<td>• Excavation of building and retaining walls &amp; backfill as required including imported material.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Installation of drainage bed of washed gravel at foundations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• All fine grading for slabs, side-walks, &amp; paving (including concrete pavement by others) to +/- .10’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Topsoil to be removed, replaced, &amp; graded back to original conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Refer to and adhere to geotechnical report included herein.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cleanup and proper disposal/storage of materials.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Subcontractor to provide and maintain all traffic control required for their own work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• SWPPP permitting, implementation, maintenance, removal &amp; reporting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Subcontractor to run all utilities to within 5’ outside of building line. Run complete storm drain system, including under the building footprint</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Subcontractor is responsible for dust control during construction.</td>
</tr>
</tbody>
</table>

All technical specifications as they apply to the work of this Bid Item.
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Subcontractor to install and remove lined pit for concrete wash out.</td>
</tr>
<tr>
<td></td>
<td>• Saw cutting for paving connection to existing South 7th Ave</td>
</tr>
<tr>
<td></td>
<td>• Asphalt paving</td>
</tr>
<tr>
<td></td>
<td>• Mobilizations as required.</td>
</tr>
<tr>
<td>Bid Item</td>
<td>Bid Item Description</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------</td>
</tr>
<tr>
<td>1.2B</td>
<td>Selective Building Demolition <em>(Page 1 of 1)</em></td>
</tr>
</tbody>
</table>

**Specifications**
- 02 4100 – Selective Demolition

**Related Specification Sections**
- Division 01 – General Requirements
- 05 1200 – Structural Steel

All technical specifications as they apply to the work of this Bid Item

**Demolition**
- Provide own means of equipment to complete demolition and removal of building components
- Provide all temporary or permanent supports, showing, structural elements, steel headers, etc. necessary to complete this scope of work
- Provide and install all structural headers required for cut openings
- Conduct pre-demolition conference prior to work beginning on site
- Owner will occupy portions of the building immediately adjacent to selective demolition area. Conduct selective demolition as to not disrupt the Owner’s operations
- Comply with notice requirements to Construction Manager and Owner as required in the specification

**Removal & Salvage**
- Detach existing items from construction in a safe manner and present materials to the owner. Legally dispose of any unwanted material off-site
- Remove and Salvage material to prevent damage and deliver to Owner ready for reuse
- Remove all demolished materials from site and dispose of in accordance with LEED requirements and any applicable laws, codes and regulations

**Removal & Reuse Preparation**
- Detach items from existing construction, prepare for reuse
- The extents of demolition include removal of existing exterior dense glass, tile backer board, insulation and existing steel studs
- The specific area for demolition to occur is found along gridline BB, from the west corner of the existing building to the easternmost part of the Schedule E.1 building, reference Sheet A1.1.

**Existing to Remain**
- Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled

**Exclusions:**
- Reinstall of any material related to this bid package
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3A</td>
<td>Furnish &amp; Install Site Concrete and all Concrete Flatwork, and miscellaneous building concrete <em>(Page 1 of 2)</em></td>
<td>This package <em>shall include</em> all required materials, labor and equipment necessary to <em>Furnish &amp; Install Site Concrete, all Concrete Flatwork, and miscellaneous building concrete</em> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td><strong>Cast-In-Place Concrete – Complete</strong></td>
</tr>
<tr>
<td></td>
<td>• 03 3000 Cast-In-Place Concrete</td>
<td>• All required concrete materials and accessories including synthetic reinforcing fibers, formwork, admixtures, and reinforcing, curing materials, bonding agents, epoxy bonding adhesives, joint filler strips and repair materials.</td>
</tr>
<tr>
<td></td>
<td>• 03 3511 Concrete Floor Finishes</td>
<td>• <strong>Building footings and Insulating Concrete Formwork by others.</strong> All other concrete by this subcontractor, including but not limited to slabs on grade, slabs on deck, site retaining walls, sidewalks, and concrete pavement. Reinforcement for these items are to be installed by this contractor, but will be supplied by the successful bidder of 1.3B.</td>
</tr>
<tr>
<td></td>
<td>• 07 9200 Joint Sealants</td>
<td>• Pumping and other means of material placement. Coordinate all pours with General Contractor.</td>
</tr>
<tr>
<td></td>
<td>• 07 9513 Expansion Joint Cover Assemblies</td>
<td>• Saw cutting for control joints.</td>
</tr>
<tr>
<td></td>
<td>• 32 1313 Concrete Paving</td>
<td>• Install all bollards (supply by others)</td>
</tr>
<tr>
<td></td>
<td><strong>Related Specification Sections</strong></td>
<td>• Subcontractor is responsible to install all construction joints, control joints, &amp; doweled joints as required</td>
</tr>
<tr>
<td></td>
<td>• Division 01 – General Requirements</td>
<td>• Subcontractor responsible for foundation wall and slab at loading dock as shown on sheet S5.01. Footing by successful bidder of 1.3B.</td>
</tr>
<tr>
<td></td>
<td>• Concrete Reinforcing Steel Institute, (CRSI) Manual of Standard Practice</td>
<td>• Subcontractor responsible for concrete slab, footing, and piers associated with South exterior stair (ref. E/S7.02)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Subcontractor to install all elements of dock leveler required to be embedded in concrete. Leveler supplied by others for this installation.</td>
</tr>
<tr>
<td></td>
<td>All technical specifications as they apply to the work of this Bid Item</td>
<td>• Subcontractor is responsible for expansion joint cover assemblies as all slab joints per plans and specifications, including but not limited to details 10 &amp; 13 on sheet A6.2. Includes saw cutting of existing slab and grout as required.</td>
</tr>
</tbody>
</table>

1.3A Furnish & Install Cast-In-Place Structural Concrete, ICFs, Sidewalks & Reinforcement *(Page 1 of 2)*
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
</table>
| 1.3A     | Furnish & Install Cast-In-Place Structural Concrete, Sidewalks & Reinforcement *(Page 2 of 2)* | **Continued...**

- Installation of all required steel embeds and anchor bolts within concrete.
- Installation of all required pipe sleeves and blockouts.
- Chamfered edges and reveal joints as required.
- Expansion material at slab on grade joints where required per details.
- Furnish and install all vapor barriers under slab including taping of all joints, piping and obstructions through the vapor barrier.
- Furnish and install all concrete sidewalks as per plans and specifications.
- Subcontractor is responsible for all slab depressions & equipment pads.
- Subcontractor responsible to comply with ACI requirements for cold & hot weather concrete placements as well as to protect concrete from physical damage caused by freezing, frost, and low or extremely high temperatures.
- Subcontractor is responsible for proper curing methods.
- The Owner will perform concrete tests during construction.
- Power trowel smooth with plastic blades only, in accordance with ACI 301 & ACI 302.1 for floor finishes to be stained and/or sealed.
- Subcontractors to follow tolerances/ variations in floor flatness as specified within Concrete Finishing spec section 03 3000, sub-section 3.06 Tolerances.

**Install all reinforcing steel for this scope of work per contract documents including but not limited to:**

- Hoisting for reinforcement is included in this scope.
- Install additional trim bar reinforcing for penetrations and openings in concrete slabs, and foundations per reinforcing details.
- Coordinate with other trades for proper sequencing of rebar placement to allow for installation of all embeds, sleeves, and other openings.
- Include all reinforcing support chairs, dobie blocks or similar to accommodate no damage to vapor barrier.
- Dowels at construction joints in coordination with concrete.
- Welded Wire Mesh as required.
- Furnish, install and maintain rebar caps for duration as require
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3B</td>
<td>Furnish &amp; Install Insulated Concrete Forms, Building Footings &amp; Reinforcement <em>(Page 1 of 2)</em></td>
<td>This package <em>shall include</em> all required materials, labor and equipment necessary to <em>Furnish &amp; Install Insulating Concrete Formwork, Building Footings &amp; Reinforcement</em> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
</tbody>
</table>

**Specifications**
- 03 1119 Insulating Concrete Forms
- 03 3000 Cast-In-Place Concrete

**Related Specification Sections**
- Division 01 – General Requirements
- Concrete Reinforcing Steel Institute, (CRSI) Manual of Standard Practice

All technical specifications as they apply to the work of this Bid Item

**Cast-In-Place Concrete – Complete**
- This subcontractor responsible for all building footings and insulating concrete formwork. Slab-on-grade, slab-on-deck, and site concrete by others.
- *Furnish ALL CONCRETE REINFORCING STEEL* per contract documents. Install concrete reinforcing steel for this scope only.
- All required concrete materials and accessories
- All bracing, scaffolding, ladders, stairs, etc. as required to support walls under construction and provide safe and complete access to this scope of work. This access is to be available to and suitable for all trades requiring access to this scope of work.
- Install ICFs to specified tolerances. Correct any work out of this tolerance affecting the installation of siding, sheathing, or GWB.
- Pumping and other means of material placement. Coordination of all pours required with General Contractor.
- Subcontractor is responsible to install all construction joints, control joints, & doweled joints as required
- Installation and templates for all required anchor bolts and embeds.
- Installation of sheet waterproofing and drainage board
- Subcontractor is responsible for installation of all embeds, drilled and grouted anchors, anchor bolts, etc. as required by drawings.
- Notification of Engineer and Construction Manager 48 hours prior to placement of any concrete. Concrete placement may be observed by Engineer.
- Subcontractor is responsible for all concrete reinforcement as required. Installation of reinforcing steel to conform to Concrete Reinforcing Steel Institute’s practice for “Placing Reinforcing Bars.”
- All reinforcement to be clean of loose rust, mill scale, earth, ice, and other materials.
- Subcontractor is responsible for all formwork materials.
- Block outs for recessed columns.
- Installation of all required steel embeds and anchor bolts within concrete or ICF’s.
- Installation of all openings required including but not limited to: pipe sleeves, duct or mechanical openings, window and door bucks.
- Prove additional bracing and support as necessary to maintain opening size through placement and cure of concrete.
- Subcontractor responsible to comply with ACI requirements for
furnish & install cast-in-place structural concrete, ICFs, sidewalks & reinforcement

<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
</table>
| 1.3B     | Furnish & Install Insulated Concrete Forms, Building Footings & Reinforcement (*Page 2 of 2*) | *Continued...*

- Furnish ALL CONCRETE REINFORCING STEEL per contract documents. Install concrete reinforcing steel for this scope only.
- Hoisting for reinforcement is included in this scope.
- Furnish and install additional trim bar reinforcing for penetrations and openings in concrete slabs, and foundations per reinforcing details.
- Coordinate with other trades for proper sequencing of rebar placement to allow for installation of all embeds, sleeves, and other openings.
- Include all reinforcing support chairs, dobie blocks or similar to accommodate no damage to vapor barrier.
- Dowels at construction joints in coordination with concrete.
- Welded Wire Mesh as required.
- Furnish, install and maintain rebar caps for duration as required.

*Continued...*
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4A</td>
<td>Furnish &amp; Install Masonry (Page 1 of 1)</td>
<td>This package shall include all required materials, labor and equipment necessary to Furnish &amp; Install Masonry for all areas of the project per the contract documents including but not limited to:</td>
</tr>
</tbody>
</table>

**Specifications**
- 04 2001 – Masonry Veneer
- 07 9200 – Joint Sealants

**Related Specification Sections**
- Division 01 – General Requirements
- Division 03 - Concrete
- 07 9513 – Expansion Joint Cover Assemblies

All technical specifications as they apply to the work of this Bid Item

**Masonry Systems - Complete**
- Access to own work.
- Sample mockup for Architect’s review and approval.
- All anchoring, fasteners, reinforcement and accessories as required for a complete installation.
- Coordination of all required structural attachments and lintels with other trades.
- All starter ledges, gaskets, adhesives, beams, and channel required for a complete installation.
- All flashing and sealants required to maintain a water tight substrate, and self-adhered formable masonry cavity flashing.
- Subcontractor is responsible for self-adhesive membrane flashing.
- Control joints, expansion joints and associated sealants.
- Cut-outs in masonry for penetrations by others.
- Coordinate penetration sleeves and penetrations with other trades.
- All masonry cleaners, sealants and finishing products
- All weep holes, cavity drainage, U-shaped mortar catches, masonry anchors, and vents required for a complete installation.
- Subcontractor is responsible for furnish/installation of precast concrete sills.
- Subcontractor is responsible for temp heating, weather protection, tenting, and maintaining minimum temperatures for mortar installation, as required.
- Subcontractor responsible for installation of angle iron lintels, ledgers, relief angles, etc. supply is by others
- Subcontractor is responsible for temporary protection of work.
- Comply with all tolerances listed in specification section 04 2001 3.10
- Cutting and fitting of individual masonry units as required
- Cleaning of completed work using cleaning solutions recommended by the manufacturer
### Bid Item Detailed Descriptions

<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5A</td>
<td>Furnish all Structural Steel, Roof Joists, Steel Decking, &amp; Miscellaneous Metals.</td>
<td>This package <strong>shall include</strong> all required materials, labor and equipment necessary to supply all Structural Steel Columns, Beams, Baseplates, Roof Joists, Steel Decking, and Miscellaneous Metal for all areas of the project per the contract documents including but not limited to:</td>
</tr>
</tbody>
</table>

#### Specifications
- 05 1200 – Structural Steel
- 05 2100 – Steel Joist Framing
- 05 3100—Steel Decking
- 05 5000 – Metal Fabrications
- 05 5100 – Metal Stairs
- 05 5213 – Pipe and Tube Railings
- 05 5305 – Gratings and Floor Plates

#### Related Specification Sections
- Division 01 – General Requirements
- Division 03 - Concrete

All technical specifications as they apply to the work of this Bid Item

#### Exclusions:
- Concrete Reinforcing Steel
- Non-Structural Metal Framing
- Framing Anchors
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5B</td>
<td>Install all Structural Steel, Roof Joists, Steel Decking, &amp; Miscellaneous Metals. (Page 1 of 1)</td>
<td>This package shall include all required materials, labor and equipment necessary install all Structural Steel Columns, Beams, Baseplates, Roof Joists, Steel Decking, and Miscellaneous Metal for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td>Structural Steel Columns, Beams, Baseplates, Roof Joists, Steel Decking, and Miscellaneous Metal Framing – Install Only</td>
</tr>
<tr>
<td></td>
<td>• 05 1200 – Structural Steel</td>
<td>• Provide and maintain perimeter safety cable per OSHA requirements throughout duration of own work at all leading edges and openings greater than 4’x4’.</td>
</tr>
<tr>
<td></td>
<td>• 05 2100 – Steel Joists Framing</td>
<td>• Provide all offloading and hoisting required to complete this scope of work</td>
</tr>
<tr>
<td></td>
<td>• 05 3100 – Steel Decks</td>
<td>• Coordination of crane logistics with General Contractor</td>
</tr>
<tr>
<td></td>
<td>• 05 5000 – Metal Fabrications</td>
<td>• Install of all steel decking required as per construction documents.</td>
</tr>
<tr>
<td></td>
<td>• 05 5100 – Metal Stairs</td>
<td>• Field Welding as required.</td>
</tr>
<tr>
<td></td>
<td>• 05 5213 – Pipe &amp; Tube Railings</td>
<td>• Installation of all steel joists as required per construction documents.</td>
</tr>
<tr>
<td></td>
<td>• 05 5305 – Gratings and Floor Plates</td>
<td>• Installation of all structural steel as required per construction documents.</td>
</tr>
<tr>
<td></td>
<td><strong>Related Specification Sections</strong></td>
<td>• Installation of all steel deck</td>
</tr>
<tr>
<td></td>
<td>• Division 01 – General Requirements</td>
<td>• Installation of all steel grating</td>
</tr>
<tr>
<td></td>
<td>• Division 03 -- Concrete</td>
<td>• Installation of all metal stairs and ladders</td>
</tr>
<tr>
<td></td>
<td>All technical specifications as they apply to the work of this Bid Item</td>
<td>• Installation of all handrail connected to steel stair stringers or other steel building element. Wall mounted handrail by others</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Special care shall be taken for the installation of all exposed steel.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Furnish &amp; Install of all Grouting for structural steel column base plates (as related to this scope of work) is the responsibility of this subcontractor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provide all off-loading, equipment, rigging &amp; lifting as required.</td>
</tr>
</tbody>
</table>

**Exclusions:**
- Concrete Reinforcing Steel
- Cast-in-Place Anchor Bolts
- Non-Structural Metal Framing
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5C</td>
<td>Supply and Install all Structural Steel, Roof Joists, Steel Decking, &amp; Miscellaneous Metals. <em>(Page 1 of 1)</em></td>
<td>This package <em>shall include</em> all required materials, labor and equipment necessary Supply and Install all Structural Steel Columns, Beams, Baseplates, Roof Joists, Steel Decking, and Miscellaneous Metal for all areas of the project per the contract documents including but not limited to:</td>
</tr>
</tbody>
</table>

**Specifications**
- 05 1200 – Structural Steel
- 05 2100 – Steel Joists Framing
- 05 3100 – Steel Decks
- 05 5000 – Metal Fabrications
- 05 5100 – Metal Stairs
- 05 5213 – Pipe & Tube Railings
- 05 5305 – Gratings and Floor Plates

**Related Specification Sections**
- Division 01 – General Requirements
- Division 03 -- Concrete

All technical specifications as they apply to the work of this Bid Item |

<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
</table>

- Bidder may provide a bid under this bid package for the supply and installation of all structural steel, deck, joists, and miscellaneous metals
- Owner and construction manager will make the subcontractor selection from bid packages 1.5A, 1.5B and 1.5C that will have the greatest benefit to the project
- Bidders of this bid package are to include all items described in bid packages 1.5A and 1.5B for a complete supply and installation scope
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5D</td>
<td>Furnish and Install all Cold Formed &amp; Non-Load Bearing Metal Stud Framing <em>(Page 1 of 1)</em></td>
<td>This package <strong>shall include</strong> all required materials, labor and equipment necessary <strong>Furnish &amp; Install all Cold Formed &amp; Non-Load Bearing Metal Stud Framing</strong> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 05 4000 – Cold Formed Metal Stud Framing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 09 2116 – Gypsum Board Assemblies</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Related Specification Sections</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Division 01 – General Requirements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Division 03 – Concrete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 05 1200 – Structural Steel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 05 2100 – Steel Joist Framing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 05 3100 – Steel Decking</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All technical specifications as they apply to the work of this Bid Item</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Cold Formed &amp; Non-Load Bearing Metal Stud Framing – Furnish and Install</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Furnish/Install all cold formed metal stud framing.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Furnish/Install all cold formed metal stud parapet walls.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Furnish/Install all hat furring channels as indicated on the drawings.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Furnish/Install all non-load bearing metal stud framing complete including but not limited to interior walls, suspended ceilings, furring channels, resilient channels and accessories.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Furnish/Install all U-channel bracing within cold framed walls, necessary attachments, and anchoring systems to the concrete per the structural drawings.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Furnish/Install all box header beams</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Provide deflection tracks as required.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Subcontractor is responsible for providing equipment, materials, and tools necessary to perform the work as needed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Subcontractor is responsible for installation of sill seal where indicated, per the drawings.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Coordinate with rough carpentry contractor to allow installation of all backing and blocking as required</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Utilize fasteners that will allow for the flush installation of drywall over the framing installed in this scope</td>
<td></td>
</tr>
<tr>
<td>Bid Item</td>
<td>Bid Item Description</td>
<td>Bid Item Notes</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>1.6A</td>
<td>Furnish &amp; Install Carpentry, Casework, &amp; Miscellaneous Blocking <em>(Page 1 of 1)</em></td>
<td>This package <strong>shall include</strong> all required materials, labor and equipment necessary to <strong>Furnish &amp; Install Rough Carpentry, Casework, &amp; Miscellaneous Blocking</strong> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td><strong>Rough Carpentry, Casework, &amp; Miscellaneous Blocking</strong></td>
</tr>
<tr>
<td></td>
<td>• 05 5213 – Pipe &amp; Tube Railings</td>
<td>• Refer to and coordinate with all related sections as detailed in the contract documents.</td>
</tr>
<tr>
<td></td>
<td>• 06 1000 – Rough Carpentry</td>
<td>• Provide blocking within walls for all items regardless if provided by the contractor or owner.</td>
</tr>
<tr>
<td></td>
<td>• 06 4100 – Architectural Wood Casework</td>
<td>• Provide blocking within walls for all accessories, appliances, cabinets, countertops, desks, dispensers, etc. As recommended by manufacturer.</td>
</tr>
<tr>
<td></td>
<td>• 01 2300 - Alternates</td>
<td>• Install all wall-mounted handrail</td>
</tr>
<tr>
<td></td>
<td><strong>Related Specification Sections</strong></td>
<td>• Provide all hardware needed to complete wood-wood and/or wood-metal connections.</td>
</tr>
<tr>
<td></td>
<td>• Division 01 – General Requirements</td>
<td>• Subcontractor responsible for all treated lumber supply/install, including but not limited to: parapet cap, nailers, sloped blocking, door and window bucks.</td>
</tr>
<tr>
<td></td>
<td>• Division 10 - Specialties</td>
<td>• Furnish &amp; Install all wood sheathing, as required per the drawings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Furnish and install all ½” plywood and vapor barrier lining in the collection storage areas per plan and specification.</td>
</tr>
<tr>
<td></td>
<td>All technical specifications as they apply to the work of this Bid Item</td>
<td>• ICF Contractor will provide tolerances per ACI. All substrate prep for plywood sheeting within this tolerance is the responsibility of this contractor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Subcontractor is responsible for all connections, fasteners, hardware, etc. as necessary for a complete installation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provide alternate price for casework based on specification 01 2300 1.03.A alternate No. 1 - Casework</td>
</tr>
<tr>
<td>Bid Item</td>
<td>Bid Item Description</td>
<td>Bid Item Notes</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>1.7A</td>
<td>Furnish &amp; Install Thermal Insulation and Vapor Barriers <em>(Page 1 of 1)</em></td>
<td>This package <em>shall include</em> all required materials, labor and equipment necessary to <strong>Furnish &amp; Install Thermal Insulation &amp; Vapor Barriers</strong> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td>General</td>
</tr>
<tr>
<td></td>
<td>• 07 2100 – Thermal Insulation</td>
<td>• Refer to and coordinate with all related sections as detailed in the contract documents</td>
</tr>
<tr>
<td></td>
<td>• 07 2500 – Weather Barriers</td>
<td>• Provide all off loading, equipment, rigging and lifting as required</td>
</tr>
<tr>
<td></td>
<td><strong>Related Specification Sections</strong></td>
<td>• Furnish and Install all batt insulation</td>
</tr>
<tr>
<td></td>
<td>• Division 01 – General Requirements</td>
<td>• Furnish and Install vapor barrier membrane for exterior stud wall cavities, as shown on wall section drawings.</td>
</tr>
<tr>
<td></td>
<td>• 09 2116 – Gypsum Board Assemblies</td>
<td>• Unfaced fiberglass batt insulation for filling of exterior window and door perimeter voids</td>
</tr>
</tbody>
</table>

All technical specifications as they apply to the work of this Bid Item

**Exclusions:**

- Rigid insulation and Zee Furring
- Membrane Roofing Insulation
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.7B</td>
<td><strong>Furnish &amp; Install Metal Siding (Page 1 of 1)</strong></td>
<td>This package shall include all required materials, labor and equipment necessary to <strong>Furnish &amp; Install Metal Siding &amp; Sill Copings</strong> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td>Metal Siding &amp; Sill Copings – Complete</td>
</tr>
<tr>
<td></td>
<td>• 07 2500 – Weather Barriers</td>
<td>• Furnish and install all weather barrier</td>
</tr>
<tr>
<td></td>
<td>• 07 4213 – Metal Wall Panels</td>
<td>• Install a mock-up for architect’s approval. Mock up may be integrated into permanent work.</td>
</tr>
<tr>
<td></td>
<td>• 07 6200 – Sheet Metal Flashings and Trim</td>
<td>• Furnish and install all metal siding, fasteners, pop rivets, and sealants as required for a complete installation.</td>
</tr>
<tr>
<td></td>
<td>• 07 9200 – Joint Sealants</td>
<td>• Furnish and install all trims as required for a complete and watertight installation.</td>
</tr>
<tr>
<td></td>
<td>• 07 9513 – Expansion Joint Cover Assemblies</td>
<td>• Furnish and install all joint sealants as required for a complete and watertight installation.</td>
</tr>
<tr>
<td></td>
<td><strong>Related Specification Sections</strong></td>
<td>Subcontractor shall install metal siding in accordance with the tolerances set forth within the specifications.</td>
</tr>
<tr>
<td></td>
<td>• Division 01 – General Requirements</td>
<td>Furnish and install all exterior wall joints per 07 9513 2.02.D Exterior Wall Joints Subject to Seismic Movement</td>
</tr>
<tr>
<td></td>
<td>• 06 1000 – Rough Carpentry</td>
<td>Exclusions:</td>
</tr>
<tr>
<td></td>
<td>All technical specifications as they apply to the work of this Bid Item</td>
<td>• Parapet Cap, Gutters, Downspouts, Termination Bars, and Metal Gravel Stop Flashings.</td>
</tr>
<tr>
<td>Bid Item</td>
<td>Bid Item Description</td>
<td>Bid Item Notes</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------</td>
<td>----------------</td>
</tr>
</tbody>
</table>
| 1.7C     | Furnish & Roofing, Gutters, Downspouts, Parapet Cap & Copings  
*Page 1 of 2* | This package **shall include** all required materials, labor and equipment necessary to Furnish & Install Roofing, Gutters, Downspouts, Parapet Cap & Copings for all areas of the project per the contract documents including but not limited to:  

**Specifications**  
- 07 5419 – PVC Thermoplastic Single-Ply Roofing  
- 07 6200 – Sheet Metal Flashing and Trim  
- 07 7100 – Roof Specialties  
- 07 9200 – Joint Sealants  
- 07 9513 – Expansion Joint Cover Assemblies  

**Related Specification Sections**  
- Division 01 – General Requirements  
- 06 1000 – Rough Carpentry  
- 07 7200 – Roof Accessories  
- 07 9200 – Joint Sealants  

All technical specifications as they apply to the work of this Bid Item  

**General**  
- Prior to application, subcontractor shall inspect all surfaces to membrane roofing system and flashing/sheet metal systems. Subcontractor’s acceptance shall be submitted in writing prior to application of materials. Failure to submit letter of acceptance shall constitute acceptance.  
- Coordinate membrane roofing and flashing/sheet metal with contractors providing substrates or accessories integral to the roofing systems ensure a complete and watertight system  
- Coordinate the gutter system requirements with the plumbing subcontractor to ensure a complete and watertight system.  
- Haul off and offsite disposal of excess materials, packaging, and scraps generated by this scope of work in accordance with LEED requirements and any applicable laws, codes, and regulations.  

**Provide complete membrane roofing system as specified in contract documents including:**  
- Membrane roofing and vapor retarder  
- Adhesives and sealants  
- Roof insulation and Cover Boards  
- Crickets  
- Flashings and Miscellaneous Materials integral to the roofing system  
- Manufacture roof specialties/parapet coping/gravel stop coping  
- Metal Roof Gutters, Cleats, Flashings, and Trims  
- Walkway Pads  
- Provide roof jacks, boots, etc. for all roof penetrations as required for Polyvinyl Chloride roofing.  
- Furnish and Install rigid and tapered insulation required for a complete roofing system.  
- Subcontractor to install all hardware, fasteners, etc. for a complete installation.  
- Install all flashings around curbs as necessary.  
- Subcontractor is responsible for furnish and install of all roof drains & roof scuppers as required.  

---

1.7C- Furnish & Install Roofing, Gutters, Downspouts, Parapet Cap & Copings (Page 1 of 2)
| 1.7C | **Furnish & Roofing, Gutters, Downspouts, Parapet Cap & Copings (Page 2 of 2)** | **Provide complete membrane roofing system as specified in contract documents including:**  
- Furnish and Install all termination bars.  
- Subcontractor is responsible for any temp heating requirements and weather protection/tenting as required.  
- Furnish and Install all roof board as required.  
- Furnish and Install Expansion Joints per 07 9513 2.02.C  
  Exterior Roof to Wall Joints Subject to Seismic Movement |
### Bid Item Detailed Description

<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8A</td>
<td>Furnish &amp; Install Doors, Frames, &amp; Hardware (Page 1 of 2)</td>
<td>This package <strong>shall include</strong> all required materials, labor and equipment necessary to <strong>Furnish &amp; Install Doors, Frames, &amp; Hardware</strong> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
</tbody>
</table>

**Specifications**
- 08 1113 – Hollow Metal Doors and Frames
- 08 7100 – Door Hardware

**Related Specification Sections**
- Division 01 – General Requirements
- 08 8000 – Glazing
- 09 2116 – Gypsum Board Assemblies
- 09 9113 – Exterior Painting
- 09 9123 – Interior Painting
- 23 3300 – Air Duct Accessories
- Division 8 – Automatic Door Operators
- Division 28 – Access Control
- Division 28 – Fire Detection and Alarm Interfaces

All technical specifications as they apply to the work of this Bid Item

- **Doors, Frames, & Hardware– Complete**
  - Subcontractor is responsible to provide a complete, fully-functional, and code-compliant hardware package for each opening; including all hardware, accessories, and components required regardless of whether shown or scheduled.
  - Furnish, install and verify door and frame labels. Labels shall be provided as required by all governing agencies having jurisdiction over the project, regardless of whether shown or scheduled.
  - Provide all doors and frames with required cut-outs and reinforcing for all hardware.
  - Coordinate hollow metal frame anchors with framing Subcontractor during the submittal process and prior to fabrication of door frames.
  - Subcontractor shall make adjustments to the installed door assemblies during balancing of the HVAC system to ensure proper operation of all doors.
  - Subcontractor shall coordinate with Flooring Subcontractors to ensure correct door undercuts and installation of all floor mounted hardware.
  - Field verify that all door frames are installed within acceptable tolerances during the framing process and prior to door installation.
  - Doors and frames will be received and inventoried by this Subcontractor. Once doors are inventoried they will be accepted by this Subcontractor who is then responsible for distribution of doors.
  - Subcontractor understands all hollow metal frames shall be painted prior to installation of doors and door hardware. Subcontractor shall exercise care when installing doors. All touch-up required due to this Subcontractor’s operations shall be charged to this subcontractor.
  - Mutes and smoke seals for all door frames are included, if required. Scheduled hinges shall be reviewed during the submittal phase to ensure proper offsets are specified in the hinge to allow for proper closing of the door(s) which require mutes and/or smoke seals, under all circumstances. If offset hinges are not called out, Subcontractor shall confirm that doors have proper bevels or other means to allow for closing of the door.
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8A</td>
<td>Furnish &amp; Install Doors, Frames, Hardware, &amp; Security Hardware (Page 2 of 2)</td>
<td>continued...</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• All electric hardware unless specifically noted otherwise</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Coordination with electrical Subcontractor for security door installation, any power requirements are to be installed by the electrical contractor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• FOB shop-primed door lite vision frames</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• All labor materials and equipment necessary to complete this scope of work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provide all off-loading, equipment, rigging &amp; hoisting required</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Furnish all door hardware for aluminum storefront doors.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Furnish and install all security door hardware, such as controlled access doors.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tie-ins to the fire alarm system shall be coordinated with the fire alarm contractor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Owner shall submit a keying schedule, in which this subcontractor will be responsible for keying corresponding locksets.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• This subcontractor will mark all keys to the appropriate lockset.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Caulking of door frames will be the responsibility of others.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Exclusions</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Service windows</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Glazing and Fire Rated Glass</td>
</tr>
<tr>
<td>Bid Item</td>
<td>Bid Item Description</td>
<td>Bid Item Notes</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>1.8A</td>
<td><strong>Furnish &amp; Install Overhead Coiling and Sectional Doors (Page 1 of 2)</strong></td>
<td>This package <strong>shall include</strong> all required materials, labor and equipment necessary to <strong>Furnish &amp; Install Overhead Coiling and Sectional Doors</strong> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
</tbody>
</table>

**Specifications**
- 08 3323 – Overhead Coiling Doors
- 08 3613 – Sectional Doors

**Related Specification Sections**
- Division 01 – General Requirements
- Division 26 - Electrical

All technical specifications as they apply to the work of this Bid Item

**Overhead Coiling and Section Doors – Complete**
- Subcontractor is responsible to provide a complete, fully-functional, and code-compliant hardware package for each opening; including all hardware, accessories, and components required regardless of whether shown or scheduled.
- Furnish, install and verify door and frame labels. Labels shall be provided as required by all governing agencies having jurisdiction over the project, regardless of whether shown or scheduled.
- Provide shop drawings and submittals with required rough opening sizes and power requirements and location in a timely manner to allow coordination
- All labor materials and equipment necessary to complete this scope of work
- Provide all off-loading, equipment, rigging & hoisting
- Provide all wiring between controller and disconnects and from fire alarm as required by specification
- Provide adjusting as required by specification for smooth and noiseless operation
- Provide adjusting immediately prior to owner occupation the building

---

*1.8B- Furnish & Install Overhead Coiling and Sectional Doors Page (1 of 1)*
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8C</td>
<td>Furnish &amp; Install Aluminum Framed Entrances &amp; Storefronts and Glazing <em>(Page 1 of 1)</em></td>
<td>This package <em>shall include</em> all required materials, labor and equipment necessary to Furnish &amp; Install Aluminum Framed Entrances &amp; Storefronts and Glazing for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td><strong>Aluminum Framed Entrances &amp; Storefronts and Glazing - Complete</strong></td>
</tr>
<tr>
<td></td>
<td>• 08 8000 – Glazing</td>
<td>• Provide caulking, backer rod, and sealant based on last installer sequence</td>
</tr>
<tr>
<td></td>
<td>• 08 5113 – Aluminum Windows</td>
<td>• Furnish and install shims as required for own work</td>
</tr>
<tr>
<td></td>
<td>• 07 9200 – Joint Sealants</td>
<td>• Deliver, store, and handle materials under strict care to prevent damage and deterioration</td>
</tr>
<tr>
<td></td>
<td><strong>Related Specification Sections</strong></td>
<td>• Furnish and install glazing for all doors and interior or hollow metal windows as required</td>
</tr>
<tr>
<td></td>
<td>• Division 01 – General Requirements</td>
<td>• Install cleaners, primers, sealers as per manufacturer’s recommendations</td>
</tr>
<tr>
<td></td>
<td>• 04 2001 – Masonry Veneer</td>
<td>• Protect glass from contact with contaminating substances resulting from construction operations</td>
</tr>
<tr>
<td></td>
<td>• 07 2500 – Weather Barriers</td>
<td>• Install glazing sealants to allow for a complete and watertight system</td>
</tr>
<tr>
<td></td>
<td>• 08 1113 – Hollow Metal Doors &amp; Frames</td>
<td>• Provide all off-loading, lifting, and equipment as required.</td>
</tr>
<tr>
<td></td>
<td>• 08 7100 – Door Hardware</td>
<td>• Furnish and install any flashing required to provide for a watertight assembly</td>
</tr>
<tr>
<td></td>
<td>All technical specifications as they apply to the work of this Bid Item</td>
<td>• Subcontractor is responsible for installation of door hardware for Aluminum Entrances and Storefronts, hardware to be supplied by others.</td>
</tr>
</tbody>
</table>

**Exclusions:**

- Door Hardware to be supplied by others.
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.9A</td>
<td><strong>Furnish &amp; Install Gypsum Board Assemblies</strong> <em>(Page 1 of 1)</em></td>
<td>This package <em>shall include</em> all required materials, labor and equipment necessary to <strong>Furnish &amp; Install Gypsum Board &amp; Assemblies</strong> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 09 2116 – Gypsum Board Assemblies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 07 9513 – Expansion Joint Cover Assemblies</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Related Specification Sections</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Division 01 – General Requirements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 05 1200 – Structural Steel Framing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 06 1000 – Rough Carpentry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 07 9200 – Joint Sealants</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 09 5100 – Suspended Acoustical Ceilings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 09 9123 – Interior Painting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All technical specifications as they apply to the work of this Bid Item</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.9A- Furnish & Install Gypsum Board Assemblies *(Page 1 of 1)*
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.9B</td>
<td>Furnish &amp; Install Flooring (Page 1 of 1)</td>
<td>This package <strong>shall include</strong> all required materials, labor and equipment necessary to <strong>Furnish &amp; Install Flooring</strong> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 09 6500 – Resilient Flooring</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 09 6813 – Tile Carpeting</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Related Specification Sections</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Division 01 – General Requirements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 02 4100 – Demolition</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Division 03 – Concrete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 07 9200 – Joint Sealants</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All technical specifications as they apply to the work of this Bid Item</td>
<td></td>
</tr>
</tbody>
</table>

**Flooring & Tiling - Complete**
- Subcontractor is responsible for inspecting and examining substrates for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
- Subcontractor shall prepare substrates according to manufacturer’s written recommendations to ensure adhesion of products.
- Subcontractor shall perform adhesion tests and moisture test as recommended by the manufacturer.
- Substrate shall be installed per the tolerance for the substrate material. Subcontractor shall be responsible for meeting flooring specification, even if tolerance is tighter than substrate material.
- Subcontractor is responsible for all floor preparation. This includes but is not limited to sweep and vacuum clean substrates to be covered, examining substrates for moisture, alkaline salts, carbonation and dust, use of leveling and patching compounds, etc. as required for a proper installation. Subcontractor shall proceed with installation only after conditions are satisfactory.
- Floor prep shall be included. Concrete contractor responsible for meeting specified tolerances in Division 03. This contractor responsible for any preparation beyond this.
- **Furnish and install all flooring materials to match existing where slab in existing building is to be cut for the new plumbing tie in**
- Subcontractor shall furnish and install all carpet installation accessories. This includes but is not limited to all leveling and patching compounds, adhesives, seam adhesive, metal edge strips, etc. as required.
- Furnish and Install a complete Resilient Flooring and Base System including all Resilient tile flooring, Resilient wall base, Leveling and patching compounds, adhesives and metal edge strips.
- Furnish and install a complete Carpet Tile System including all Carpet Tile Flooring, Leveling and patching compounds, adhesives, resilient nosings and transition strips.
- Mobilizations as required.
- Subcontractor is responsible for off-loading, staging, hoisting of all materials and other components as required for this scope of work. Subcontractor shall stack and cover materials to prevent damage from weather.
- Clean up and Disposal (Daily)
- In-Place Field mock-up
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.9C</td>
<td>Furnish &amp; Install Painting &amp; Coatings <em>(Page 1 of 1)</em></td>
<td>This package <strong>shall include</strong> all required materials, labor and equipment necessary to Furnish &amp; Install Painting &amp; Coatings for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td>General</td>
</tr>
<tr>
<td></td>
<td>• 03 3511 – Concrete Floor Finishes</td>
<td>• Subcontractor is responsible for properly storing and keeping materials safe from damage or deterioration</td>
</tr>
<tr>
<td></td>
<td>• 09 9113 – Exterior Painting</td>
<td>• Supply of extra materials as per construction documents</td>
</tr>
<tr>
<td></td>
<td>• 09 9123 – Interior Painting</td>
<td>• Paint all gypsum board walls, ceilings and fire retardant plywood, except where textured acrylic coating is applied</td>
</tr>
<tr>
<td></td>
<td>• 07 9200 – Joint Sealants</td>
<td>• Painting of all exposed steel and iron work as required in contract drawings including structural steel, handrails, stairs, guardrails, access ladders, and other miscellaneous metals</td>
</tr>
<tr>
<td></td>
<td><strong>Related Specification Sections</strong></td>
<td>• Painting of HM doors, HM frames, Door Lite Frames, Access Panels, and Frames</td>
</tr>
<tr>
<td></td>
<td>• Division 01 – General Requirements</td>
<td>• Caulking around all fire extinguisher cabinets, hollow metal frames for doors and all windows.</td>
</tr>
<tr>
<td></td>
<td>• Division 03 – Concrete</td>
<td>• Touch up painting as required by damage of other trades within reason</td>
</tr>
<tr>
<td></td>
<td>• 08 1113 – Hollow Metal Doors and Frames</td>
<td>• Painting of all exterior miscellaneous metal columns, beams, support angles, etc. in relation to the canopy at the main entrance to the building.</td>
</tr>
<tr>
<td></td>
<td>• 09 2116 – Gypsum Board Assemblies</td>
<td>• Subcontractor is responsible for all surface preparation. This includes, but is not limited to: wipe down or clean substrates, preparation of surface to manufacturer’s recommendations (including sanding, scraping, grinding, etc.), removal of electrical plates, door silencers, hardware, turns, fittings, and replacement of removed items. Surfaces receiving paint shall be clean, dry, smooth, and dust free.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Subcontractor shall be responsible for caulking between painted materials and other dissimilar materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Subcontractor to furnish and install transparent finish to interior wood items scheduled to receive finish. Furnish and install filler for nail holes and cracks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Subcontractor responsible for painting any HVAC components scheduled to receive a finish.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Furnish and install paint to uncoated steel as scheduled within the plans and specifications.</td>
</tr>
<tr>
<td>Bid Item</td>
<td>Bid Item Description</td>
<td>Bid Item Notes</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>1.9D</td>
<td><strong>Furnish &amp; Install ACT/Suspended Ceilings (Page 1 of 1)</strong></td>
<td>This package <strong>shall include</strong> all required materials, labor and equipment necessary to <strong>Furnish &amp; Install ACT/Suspended Ceilings</strong> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 09 5100 – Suspended Acoustical Ceilings</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Related Specification Sections</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Division 01 – General Requirements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 09 2116 – Gypsum Board Assemblies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All technical specifications as they apply to the work of this Bid Item</td>
<td></td>
</tr>
</tbody>
</table>

**ACT/Suspended Ceilings – Complete**
- Extra Materials per specifications
- Verify that substrates are within acceptable tolerance prior to the installation of the ceiling
- Provide all eyebolts, steel stud compression posts, overhead blocking, struts, seismic supports, etc. as required for a complete installation per the reflected ceiling plans and details on sheets A2.6 and A2.7
- Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies
- Cut and install MEP device tiles out of sequence with installation of the standard ceilings tiles for all affected area. Also consider that some ties will need to be left out for MEP testing and will need to be installed out of sequence.
- Scaffolding and/or lifts as required to access own work
- Scribing of tiles
- Stud supports at obstructions
- Furnish and install a complete and code compliant Acoustical Panel Ceiling System including all acoustical panels, suspension system and accessories
- Provide all off-loading, equipment, rigging, hoisting & staging as required

**Exclusions:**
- Hard lid ceilings
- Support wires for MEP Fixtures
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.10A</td>
<td>Furnish &amp; Install Specialties (<em>Page 1 of 1</em>)</td>
<td>This package <em>shall include</em> all required materials, labor and equipment necessary to <strong>Furnish &amp; Install Specialties</strong> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td><strong>General</strong></td>
</tr>
<tr>
<td></td>
<td>10 1400 – Signage</td>
<td>• Provide shop drawings and submittals in sufficient detail and a timely manner to allow the installation of any embedded items, block-outs, rough opening, backing &amp; blocking, etc. required for later installation of items in this scope of work</td>
</tr>
<tr>
<td></td>
<td>10 2213 – Wire Mesh Partitions</td>
<td>• Site visits as required to verify blocking, backing rough openings prior to drywall</td>
</tr>
<tr>
<td></td>
<td>10 4400 – Fire Protection Specialties</td>
<td>• Furnish and install all signage per plans and specifications</td>
</tr>
<tr>
<td></td>
<td><strong>Related Specification Sections</strong></td>
<td>• Furnish and install wire mesh partitions per plans and specifications</td>
</tr>
<tr>
<td></td>
<td>Division 01 – General Requirements</td>
<td>• Furnish and install all fire protection specialties per plans and specifications</td>
</tr>
<tr>
<td></td>
<td>06 1000 – Rough Carpentry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>07 9200 – Joint Sealants</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All technical specifications as they apply to the work of this Bid Item</td>
<td></td>
</tr>
<tr>
<td>Bid Item</td>
<td>Bid Item Description</td>
<td>Bid Item Notes</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>1.11A</td>
<td><strong>Furnish &amp; Install Loading Dock Leveler</strong> <em>(Page 1 of 1)</em></td>
<td>This package <strong>shall include</strong> all required materials, labor and equipment necessary to <strong>Furnish &amp; Install Loading Dock Leveler</strong> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td><strong>General</strong></td>
</tr>
<tr>
<td></td>
<td>• 11 1319.13 – Loading Dock Leveler</td>
<td>• Provide shop drawings and submittals in sufficient detail and a timely manner to allow the procurement and installation of any elements required to be embedded in concrete</td>
</tr>
<tr>
<td></td>
<td><strong>Related Specification Sections</strong></td>
<td>• Cast in place frame to be provided to concrete contractor for installation during loading dock slab pour</td>
</tr>
<tr>
<td></td>
<td>• Division 01 – General Requirements</td>
<td>• Provide frame, leveler, vehicle restraint, deck, dock bumpers, etc. for a complete installation per plans and specifications</td>
</tr>
<tr>
<td></td>
<td>• Division 03 - Concrete</td>
<td></td>
</tr>
</tbody>
</table>
### Bid Item Detailed Description

<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.14A</td>
<td>Furnish &amp; Install Vertical Reciprocating Conveyor (Page 1 of 1)</td>
<td>This package <em>shall include</em> all required materials, labor and equipment necessary to <strong>Furnish &amp; Install Vertical Reciprocating Conveyor</strong> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
</tbody>
</table>

#### Specifications
- 14 4000 – Vertical Reciprocating Conveyor

#### Related Specification Sections
- Division 01 – General Requirements
- Division 03 - Concrete

All technical specifications as they apply to the work of this Bid Item
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.21A</td>
<td><strong>Furnish &amp; Install Fire Suppression Systems (Page 1 of 1)</strong></td>
<td>This package <em>shall include</em> all required materials, labor and equipment necessary to <strong>Furnish &amp; Install Fire Suppression Systems</strong> for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td><strong>Fire Suppression Systems - Complete</strong></td>
</tr>
<tr>
<td></td>
<td>• 21 0517 – Sleeves and Sleeve Seals for Fire-Suppression Piping</td>
<td>• Pipes, fittings, hangers, supports, earthquake bracing, valves, standpipes, backflow preventers fire department connections, dry type valves, electrical devices and specialties per the contract documents.</td>
</tr>
<tr>
<td></td>
<td>• 21 0518 – Escutcheons for Fire-Suppression Piping</td>
<td>• All underground piping assemblies require to match existing point of connection (POC) 5'-0&quot; outside of structure footprint and make all final connections, as required, for a complete systems (tested, cleaned, treated, and certified). Coordinate with Site Utility Subcontractor.</td>
</tr>
<tr>
<td></td>
<td>• 21 0553 – Identification for Fire-Suppression Piping</td>
<td>• Trenching, excavating, and backfill as required to complete your work and in conformance with the earthwork specifications.</td>
</tr>
<tr>
<td></td>
<td>• 21 1313 – Wet-Pipe Sprinkler System</td>
<td>• Identification tags, labels, signage, and markers where required on pipes, valves, and equipment.</td>
</tr>
<tr>
<td></td>
<td>• 21 1316 – Dry-Pipe Sprinkler System</td>
<td>• Sealants (fire and sound) at all walls, ceilings, and floor penetrations or interruption of rated assemblies as it applies to own work.</td>
</tr>
<tr>
<td></td>
<td><strong>Related Specification Sections</strong></td>
<td>• Furnish and install sleeves for assemblies/pipes penetrating concrete walls and embeds for own equipment/systems (when and where required) in a timely manner. Subcontractor shall layout, place all slab sleeves and embeds, and modify the metal deck assembly as required for own opening.</td>
</tr>
<tr>
<td></td>
<td>• Division 01 – General Requirements</td>
<td>• Include all related water flow and tamper switches ready for wiring by others.</td>
</tr>
<tr>
<td></td>
<td>• 07 9200 – Joint Sealants</td>
<td>• Testing and inspections as required</td>
</tr>
<tr>
<td></td>
<td>• Division 26 – Electrical</td>
<td>• Furnish and install all required equipment supports for own work and provide all leveling of own work including any equipment installed.</td>
</tr>
<tr>
<td></td>
<td>• Division 28 – Electronic Safety &amp; Security</td>
<td>• All water from system testing shall be contained and channeled out of the structure. Water is not to spill open onto finished slab or damage other finished work. Any liquids discharged shall be handled as necessary in compliance with the SWPPP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provide and maintain all necessary temporary protection for fire sprinkler head assemblies (until trim is installed).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Supply all lifts, equipment, and scaffoldings as required</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provide off-loading, staging, and hoisting as required</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provide all permits, licenses, etc. as required</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Exclusions</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Electrical wiring of any sorts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Permanent fire extinguishers</td>
</tr>
</tbody>
</table>

1.21A- *Furnish & Install Fire Sprinkler Systems (Page 1 of 1)*
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.22A</td>
<td>Furnish &amp; Install Plumbing Systems, Mechanical Piping &amp; HVAC (Page 1 of 2)</td>
<td>This package <em>shall include</em> all required materials, labor and equipment necessary to Furnish &amp; Install Plumbing Systems, Mechanical Piping &amp; HVAC for all areas of the project per the contract documents including but not limited to:</td>
</tr>
<tr>
<td></td>
<td><strong>Specifications</strong></td>
<td>Plumbing Systems, Mechanical Piping &amp; HVAC - Complete</td>
</tr>
<tr>
<td></td>
<td>• 22 0000 – Plumbing General Requirements</td>
<td>• Provide all required equipment supports for own work and provide all leveling of own work. Concrete pads to be provided by concrete Subcontractor. Layout and sizes to be provided by Subcontractor and coordinated with other trades.</td>
</tr>
<tr>
<td></td>
<td>• 22 0517 – Sleeves and Sleeve Seals for Plumbing Piping</td>
<td>• Furnish and install sleeves for assemblies, duct, and piping penetrating concrete building assemblies and embeds for own equipment/systems (when and where required) in a timely manner. Subcontractor shall layout, place all slab sleeves and embeds, and modify the metal deck assembly as required for own opening.</td>
</tr>
<tr>
<td></td>
<td>• 22 0518 – Escutcheons for Plumbing Piping</td>
<td>• Provide pre-fabricated roof curb and flashing assemblies for equipment and conduit that penetrates the roof assemblies. The horizontal finish of these assemblies shall be level and the assemblies shall be coordinated with the requirement(s) of the roofing system.</td>
</tr>
<tr>
<td></td>
<td>• 22 0523 – General Duty Valves for Plumbing Piping</td>
<td>• Provide all required “means and methods” necessary for a complete water tight condition at the exterior envelope of the building or interior areas requiring special attention including but not limited to, flashing, sealants, counter-flashings, cap sheets, and collars for own work. All assemblies shall be coordinated with the requirements of their substrates. Waterproofing by others.</td>
</tr>
<tr>
<td></td>
<td>• 22 0529 – Hangers and Supports for Plumbing Piping and Equipment</td>
<td>• Provide grouting of all Plumbing &amp; Mechanical equipment supports, stands, and applicable assemblies in this scope of work.</td>
</tr>
<tr>
<td></td>
<td>• 22 0548 – Vibration and Seismic Controls for Plumbing Piping and Equipment</td>
<td>• Sealants (fire and Sound) at all walls, ceilings, and floor penetrations or interruption of rated assemblies as it appears to own work.</td>
</tr>
<tr>
<td></td>
<td>• 22 0553 – Identification for Plumbing Piping and Equipment</td>
<td>• Testing and inspections as required</td>
</tr>
<tr>
<td></td>
<td>• 22 0719 – Plumbing Piping and Insulation</td>
<td>• Testing, Adjusting &amp; Balancing</td>
</tr>
<tr>
<td></td>
<td>• 22 1116 – Domestic Water Piping</td>
<td>• Building control systems as specified</td>
</tr>
<tr>
<td></td>
<td>• 22 1316 – Sanitary Waste and Vent Piping</td>
<td>• Subcontractor to provide all necessary information for backing to be installed by others.</td>
</tr>
<tr>
<td></td>
<td>• 22 1413 – Facility Storm Drainage Piping</td>
<td>• Provide temporary construction water for project.</td>
</tr>
<tr>
<td></td>
<td>• 22 3300 – Electric, Domestic-Water Heaters</td>
<td>• Demolition and new piping required for connections to existing building systems</td>
</tr>
<tr>
<td></td>
<td>• 22 4100 – Plumbing Fixtures</td>
<td>• Installation of valves provided by controls contractor</td>
</tr>
<tr>
<td></td>
<td>• 23 0000 – Mechanical General Requirements</td>
<td>• Provide all off-loading, equipment, rigging, hoisting and staging as required</td>
</tr>
<tr>
<td></td>
<td>• 23 0516 – Expansion Fittings and Loops for HVAC Piping</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 23 0517 – Sleeves and Sleeve Seals for HVAC Piping</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 23 0519 – Meters and Gages for HVAC Piping</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 23 0520 – BTU Meters</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 23 0523 – General Duty Valves for HVAC Piping</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 23 0529 – Hangers and Supports for HVAC Piping and Equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 23 0548 – Vibration and Seismic Controls for HVAC Piping and Equipment</td>
<td></td>
</tr>
</tbody>
</table>
- 23 0553 – Identification for HVAC Piping and Equipment
- 23 0593 – Testing, Adjusting, and Balancing for HVAC
- 23 0713 – Duct Insulation
- 23 0719 – HVAC Piping Insulation
- 23 0900 – Instrumentation and Control for HVAC
- 23 0993 – Sequence of Operation for HVAC Controls
- 23 2113 – Hydronic Piping
- 23 2123 – Hydronic Pipes
- 23 3113 – Metal Ducts
- 23 3300 – Air Duct Accessories
- 23 3713 – Diffusers, Registers, and Grilles
- 23 7200 – Air-to-Air Energy Recovery Equipment
- 23 8123 – Precision HVAC Units
- 23 8127 – VRF Heat Pump Systems

**Related Specification Sections**
- Division 01 – General Requirements
- Division 07 - Roofing
- Division 21 – Fire Suppression
- Division 26 – Electrical

All technical specifications as they apply to the work of this Bid Item

- Supply own scaffolding, ladders, man lifts need to complete this scope of work
- Include all permits, licenses, etc. as required
- Coordinate with successful bidders of 1.21A and 1.26A to ensure proper operation and commissioning of all work.
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.26A</td>
<td>Furnish &amp; Install Electrical Lighting &amp; Power Systems, Including Fire Alarm &amp; Data/Communications</td>
<td>This package shall include all required materials, labor and equipment necessary to Furnish &amp; Install Electrical Lighting &amp; Power Systems, Including Fire Alarm &amp; Data/Communications for all areas of the project per the contract documents including but not limited to:</td>
</tr>
</tbody>
</table>

**Specifications**
- 26 0519 - Low-Voltage Electrical Power Conductors and Cables
- 26 0526 - Grounding and Bonding for Electrical Systems
- 26 0529 – Hangers and Supports for Electrical Systems
- 26 0533 – Raceways and Boxes for Electrical Systems
- 26 0548 – Vibration and Seismic Controls for Electrical Systems
- 26 0553 – Identification for Electrical Systems
- 26 0923 – Lighting Control Devices
- 26 2413 – Disconnect Meter Cabinet
- 26 2416 – Panelboards
- 26 2726 – Wiring Devices
- 26 2813 – Fuses
- 26 2816 – Enclosed Switches and Circuit Breakers
- 26 5100 – Lighting
- 26 5119 – LED Interior Lighting
- 27 0528 – Pathways for Communications Systems
- 27 0544 – Sleeves and Sleeve Seals for Communications Pathways and Cabling
- 27 1100 – Communications Equipment Room Fitting
- 27 1300 – Communications Backbone Cabling
- 27 1500 – Communications Horizontal Cabling
- 28 3111 – Digital, Addressable Fire-Alarm System

**Related Specification Sections**
- Division 01 – General Requirements
- Division 21 – Fire Suppression
- Division 22 - Plumbing
- Division 23 - Mechanical

**Electrical Lighting & Power Systems, Including Fire Alarm & Data/Communications – Complete**

- Provide all electrical, communication, and fire alarm demolition and rework for connection to existing building.
- Furnish and install sleeves for assemblies/pipes penetrating walls and embeds for own equipment/systems (when and where required) in a timely manner. Subcontractor shall layout, place all slab sleeves and embeds, and modify the metal deck assembly as required for own opening.
- Provide all necessary embeds in equipment pads. Coordinate installation of embeds with the concrete Subcontractor. All embeds shall be inspected, approved, and signed off by the GC prior to concrete pour.
- Provide all required equipment supports for own work and provide all leveling of own work. Concrete pads to be provided by concrete Subcontractor. Layout and sizes to be provided by Subcontractor and coordinated with other trades.
- Provide all required “means and methods” necessary for a complete water tight condition at the exterior envelope of the building or interior areas requiring special attention including but not limited to, flashing, sealants, counter-flashings, cap sheets, and collars for own work. All assemblies shall be coordinated with the requirements of their substrates. Waterproofing by others.
- Provide grouting of all electrical equipment supports, stands, and applicable assemblies in this scope of work.
- Provide all temporary construction power and lighting to meet OSHA standards, including for elevator construction and for testing of equipment and power for temporary construction use. Provide all required engineering, material and labor required to install, maintain, relocate (as necessary – at GC/CM direction), and disassemble temporary electrical system, Task lighting to be provided by each individual trade.
- Sealants (fire and Sound) at all walls, ceilings, and floor penetrations or interruption of rated assemblies as it appears to own work.
- Trenching, excavating, and backfill as required to complete your work and in conformance with the earthwork specifications.
- Testing and Inspections as required.
- Assist with Testing, Adjusting, & Balancing.
<table>
<thead>
<tr>
<th>Bid Item</th>
<th>Bid Item Description</th>
<th>Bid Item Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.26A</td>
<td>Furnish &amp; Install Electrical Lighting &amp; Power Systems, Including Fire Alarm &amp; Data/Communications <em>(Page 2 of 2)</em></td>
<td>Continued….</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Furnish and install all required equipment supports for own work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- All required access panels &amp; doors for own work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Subcontractor to provide all necessary information for backing to be installed by others</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Power &amp; connection to all VFDs &amp; control panels.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Conduit, wire, and power for all flow, tamper switches</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Furnish all coordination, rough-in and final connections to all items as they relate to the scope of the electrical work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- All rough-in of conduit, cabling, and wiring as required to complete fire alarm and data/communications scope of work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Provide all off-loading, equipment, rigging, hoisting and staging as required</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Supply own scaffolding, ladders, man lifts need to complete this scope of work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Include all permits, licenses, etc. as required</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Coordinate with successful bidders of bid packages 1.22A and 1.21A to ensure proper operation and commissioning of all work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Provide all cable trays as required.</td>
</tr>
</tbody>
</table>
Museum of the Rockies Collections & Storage Facility
Bozeman, MT

5. GENERAL REQUIREMENT SPECIFICATIONS:

General Scope Requirements for all bid packages:

The following items will become a part of all subcontracts. Please review them carefully.

- Prior to mobilization on site, subcontractor must submit to Jackson Contractor Group, Inc. a written Safety Plan or a copy of the company's safety program. The subcontractor must submit the name of the individual who is responsible for the implementation of the safety plan or program. This individual must have authority to direct job site foremen and superintendents to comply with company directives. No payments for any work performed on the project will be made until satisfactory completion of the foregoing requirements.

- Subcontractor agrees that if in the performance of this subcontract it becomes necessary, convenient or advisable to remove, replace or interfere with any safety devices or controls installed by the contractor or another subcontractor; this subcontractor will replace or restore such devices or controls at his expense. In the event such safety devices or controls are not so replaced or restored, subcontractor agrees to reimburse the contractor for doing so for subcontractor’s account.

- The subcontractor shall be responsible for material handling and hoisting its materials, supplies and equipment and for its own scaffolding.

- Water will be available from a single source near the building pad provided by plumber.

- Each subcontractor is responsible for acceptance of the site prior to commencement of the project. The specifications require all unimproved portions of the site be returned to the condition the site was in prior to the start of any work. All debris, whether on the surface or below the surface, must be removed.

- This subcontractor shall comply with OSHA law that requires any and all suppliers or manufacturers to supply a Material Safety Data Sheet (MSDS) for products used on the above-mentioned job. Jackson Contractor Group, Inc. will be making periodic requests for this information as required. This subcontractor agrees to comply with these requirements in a timely manner.

- Pursuant to Provisions of the subcontract, an essential subcontract requirement shall be completion of work activities within the time durations provided in the project schedule. This subcontractor must review the work to familiarize itself with the time required for construction and recognize the possibility of multiple move-ins, overtime, and shift work to complete its scope of work as required by the project schedule. If subcontractor fails to meet scheduled completion dates for individual activities, Jackson Contractor Group, Inc. shall have the right to require additional manpower and/or multiple shift work of the subcontractor at no cost to Jackson Contractor Group until the delayed activity has been corrected. Subcontract will also be responsible for the cost of accelerating subsequent trades if required by subcontractor’s failure to meet schedule requirements.

- Coordination with other trades will be the responsibility of the subcontractor. Subcontractor shall provide coordination drawings as required. Interference due to lack of complete coordination will be the responsibility of each subcontractor. Potential
conflicts, delays, and quality concerns must be aggressively pursued by the subcontractor with the other trades before they affect the construction progress.

- This subcontractor shall provide fire extinguishers, flash screens, and watchmen at the location of welding and torch cutting. The subcontractor is responsible for procuring any required cutting and burning permits if required. Protection of all work is included.
- Individual task lighting for remote location or individual rooms will be the responsibility of each subcontractor for the satisfactory performance of its work.
- Subcontractor is responsible for its' own cutting, patching, and coring.
- Subcontractor shall provide fire safing, fire/security sealants, escutcheons, and sleeves, for all penetrations through walls, slabs, floors, and roofs where required by the documents.
- Subcontractor shall be responsible for all notes and details pertaining to its scope of work, regardless of what area of the plans or specifications the notes and/or details are found.
- Contractor will not provide telephone service, temporary fences, barricades, field office, field office electricity or laydown areas, or subcontractors/vendors. Temporary toilets will be provided. Construction water will be made available at a source close to the work area. All distribution is by the Subcontractor. The Subcontractor is responsible for all drinking water and ice required for its work force.
- Each subcontractor is required to maintain monthly as-built drawing updates. This is a requirement before receiving monthly progress payments. The master set will be located in Jackson Contractor Groups site offices. All underground conduit and piping must be identified and dimensioned off grid line.
- The project superintendent will schedule weekly coordination meeting with all subcontractors and major material suppliers to review job progress, resolve problems and disseminate information concerning schedules, changes or any other matters of general information. Attendance at these meetings is mandatory. Failure of subcontractor to attend regular scheduled meetings will not relieve the subcontractor of its responsibility to perform work or otherwise comply with instructions given out during the meeting.
- Weekly Tool Box Safety Meetings will be held by all subcontractors. Subcontractor will furnish meeting notes to Jackson Contractor Group, Inc. on a weekly basis. Special safety meetings will be scheduled by Jackson Contractor Group, Inc. from time to time as job conditions warrant. Subcontractors notified of these safety meetings will be expected to have their representatives in attendance.
- Subcontractor shall provide temporary protection for all work adjacent to or susceptible to damage by its own work, including, but not limited, to protection of floors, walls, ceilings, roofs, fixtures, and mechanization equipment. Costs to repair damaged work will be the responsibility of each subcontractor. The decision of the Jackson Contractor Group Superintendent shall be final in determining who damaged, or likely damaged the work.
- Each subcontractor shall organize all loose materials to the greatest extent possible and shall coordinate storage with the project superintendent.
- The subcontractor will make arrangements to remove from the work area all debris cartons, crates, and boxes at the end of each day. This debris will be deposited in dumpsters furnished by Jackson Contractor Group. Work areas are to be maintained in a broom clean condition. Inform your superintendent or foreman of this requirement. Should you fail or refuse to perform the clean up, the Jackson Contractor Group, Inc. superintendent shall cause this work to be performed by others and the entire cost thereof, plus handling charges for removal to the dump, will be assessed against the party responsible. One day's verbal notice to the subcontractor's field foreman or leadman is all that will be given. The decision of the Jackson Contractor Group, Inc. superintendent shall be final in determining when the safety and good order of the project require the clean up to be performed.
- Subcontractor will provide dust control for its own work.
- This subcontract includes spare parts, training, O & M manuals and all other close out requirements as specified. No payments beyond 80% of the contract value will be made prior to submission of required O & M manuals.
• Provide any embeds or sleeves required for casting into walls, footings, or slabs. Subcontractor shall be responsible for the timely furnishing, layout and installation of all nailers, insets, blockouts, penetrations, sleeves, etc., as may be specified and/or required for their scope of work.

• Access doors are to be provided as required for your work. All access panel locations must be provided to the Contractor framing the opening prior to constructing the element to receive the access door. Failure to locate panels will result in your account being charged the cost of reframing and repairing finishes if necessary.

• All materials delivered to the site will be scheduled with the Jackson Contractor Group site superintendent 48 hours prior to delivery. All necessary security forms and procedures as outlined in the division 1 specifications shall be strictly followed in their entirety. All traffic control (i.e. flagmen, etc.) will be provided by this Subcontractor for his deliveries. There will be no onsite storage of materials unless specifically approved by the superintendent. All unscheduled deliveries will be turned away. The Subcontractor assumes all protection and liability for material stored onsite. Refer to project specifications for specific routing of all deliveries.

• All change orders must be processed in a timely manner and must be submitted in full analytical detail as required by the Owner.

• Jackson Contractor Group Personal Protective Equipment (PPE) requirements are to be adhered to at all times. Additional PPE to be used as required by law as work activity requires.

• Safety violations will be enforced financial as follows. 1st time offence will be a written warning sent to your office, 2nd offence will be a written violation and a $50.00 penalty deducted from your monthly pay request/retention, 3rd offence same as second but $100.00, and so on. These violations are not per employee and are per company. Repeat offenders will be removed at the discretion of Jackson Contractor Group, Inc.

• Bidders shall be a licensed contractor in the State of Montana.
6. SCHEDULE
<table>
<thead>
<tr>
<th>Name</th>
<th>Start</th>
<th>Finish</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadrant Service &amp; Reception</td>
<td>6/5/2016</td>
<td>6/5/2016</td>
<td>Quadrant Service &amp; Reception</td>
</tr>
<tr>
<td>Core Cleanup</td>
<td>6/5/2016</td>
<td>6/5/2016</td>
<td>Core Cleanup</td>
</tr>
</tbody>
</table>

MoR CCH Construction CPM

5/31/2016   Page 1 of 1

Planned by Asta Powerproject
Museum of the Rockies Collections & Storage Facility
Bozeman, MT

7. SAMPLE SUBCONTRACT
JACKSON CONTRACTOR GROUP, INC.
SUBCONTRACT AGREEMENT

This agreement (hereinafter “Subcontract”) is between
Jackson Contractor Group, Inc.
P.O. Box 967
Missoula, MT 59806
Phone: 406-542-9150
Fax: 406-542-3515
(hereinafter “Contractor”), and

<SUBCONTRACTOR>                               Contact:
<Address>                                          Phone:
(hereafter “Subcontractor”).

Contractor has entered into a contract with

State of Montana – Montana State University
Facilities Planning Design & Construction
PO Box 172760
Bozeman, Montana 59717-2760
(hereafter “Owner”)

to perform certain labor and furnish materials for the construction and completion of

Museum of the Rockies Collections & Storage Facility
600 West Kagy Blvd
Bozeman, Montana 59717

The documents include:
1) Contract between Owner and Contractor, dated ____________________.
2) General, Supplementary and Special Conditions.
3) Project Specifications.
4) Project Drawings.
5) Addenda Nos.: ____________________________________________________________________.

as prepared by

Slate Architecture
107 West Lawrence Street
Helena, Montana 59601

all of which documents are hereinafter referred to as the “Main Contract.”

In consideration therefore, Subcontractor agrees as follows:

1. Subcontractor shall provide all supervision, materials, labor, supplies, services, equipment and all other items
   necessary to complete the work set forth below and which may further be described in Appendix 1 (hereafter
   “Subcontract Work”):

   [Description of Work]
Subcontractor shall provide the Subcontract Work in strict accordance with the Main Contract, which has been made, and remains, available to Subcontractor for review, the provisions of which are expressly incorporated herein by this reference.

2. Subcontractor is to provide bond[s] for its Subcontract Work at this time (Yes_______; No ______).

Contractor has the option to require this Subcontractor to obtain a 100% Performance and Payment Bond at any time during the life of this Subcontract; Subcontractor to be reimbursed for actual bond costs.

3. Subcontractor agrees to be bound by all of the terms of this Subcontract, including the General Conditions of this Subcontract Agreement, all Appendices and any other attachments to this Subcontract.

Appendix descriptions: 1 — Scope of Work ☑
2 — Insurance ☑
2A – Professional Liability Insurance ☐
3 — Indemnification ☑
4 – Guaranty Agreement ☐
5 – Special Provisions ☐
6 – Subcontractor & Major Supplier Affidavit ☑

For the full, complete and faithful performance of this Subcontract, Contractor agrees to pay Subcontractor (hereafter “Subcontract Price”):

[ ] (a) a lump sum in the amount of _________________________________ Dollars ($_____),

OR

[ ] (b) according to unit prices as set forth in Appendix 1 here following on the basis of the Owner’s or Contractor’s estimated quantities, which yields a gross Subcontract Price of approximately ___________________________________ Dollars ($______)

Unless otherwise stated, the Subcontract Price includes all applicable sales and use taxes.

This Subcontract must be executed below by an officer or duly authorized representative of Subcontractor without modification, and returned to Contractor within fifteen (15) days of its receipt. If not, and if Subcontractor elects to perform any of the Subcontract Work without first securing a fully executed Subcontract, then Subcontractor shall be deemed to have accepted this Subcontract unmodified, as issued. The effective date of this Subcontract shall be the earlier of fifteen (15) days following its receipt by Subcontractor, or the date of Subcontractor’s signature without modification. Subcontractor’s delivery to Contractor of the executed Subcontract without modification, along with suitable bonds, if required herein, and proof of insurance as required herein, are all express conditions precedent to any payment to Subcontractor.

IN WITNESS WHEREOF, Contractor and Subcontractor have executed this Agreement.

Jackson Contractor Group, Inc. [SUBCONTRACTOR]

By ________________________________________________
CONTRACTOR (Authorized Signature) SUBCONTRACTOR (Authorized Signature)

Name & Title _____________________________ _____________________________

50924 Contractor Registration Number Contractor Registration Number

Date _____________________________ Federal Tax I.D. Number

1st Tier 2014 2
Jackson Contractor Group, Inc.  
General Conditions of Subcontract Agreement

A. GENERAL RESPONSIBILITIES

1. With respect to the Subcontract Work, Subcontractor agrees to be bound to Contractor by all of the terms and provisions of the Main Contract, and to assume toward Contractor all of the duties, obligations and responsibilities that Contractor by the Main Contract assumed toward Owner. Subcontractor agrees further that Contractor shall have the same rights and remedies against the Subcontractor as Owner, under the terms and provisions of the Main Contract, has against Contractor, with the same force and effect as though every such right and remedy were set forth herein in full. The terms and provisions of this Subcontract are intended to be and shall be in addition to and not in substitution for any of the terms and provisions of the Main Contract.

2. The provisions of this Subcontract and the Main Contract are intended to supplement and complement each other and shall, where possible, be thus interpreted. Barring other direction from Contractor, the interpretation that is more costly to or which imposes the greater duty upon the Subcontractor shall control, and if that guideline does not resolve the conflict, then the terms of this Subcontract shall control.

3. Subcontractor acknowledges the Subcontract Work may or may not be entirely contained in specification sections or plan sheets in the Main Contract where such work is customarily found. Subcontractor shall perform any work reasonably inferred from the description of Subcontract Work that may be located outside of its customary location in the Main Contract.

4. Subcontractor understands that Contractor may have entered into labor agreements with labor unions and Subcontractor hereby represents that it has made its own independent investigation of the terms of those agreements. Subcontractor agrees to comply with all of the terms and conditions of those agreements applicable to the work herein undertaken to be performed by Subcontractor.

5. Subcontractor agrees not to delay or permit the delay of work on account of any labor disputes or difficulties and to indemnify and hold Contractor harmless from any loss, damage, expense or delay, including attorney fees, occasioned by any labor disputes or labor difficulties of whatever nature or cause. In the event of any threatened strike, picket or labor activities that might delay the progress of the work because of any labor disputes or action or inaction by the Subcontractor, Contractor shall have the recourses available to it under Article R of this Agreement.

6. Contractor has implemented a Safety Program (hereafter "Program") which shall apply to the Project. Subcontractor agrees that it, its employees and its lower tier subcontractors and their employees shall be bound by and shall comply with the Program and any other program implemented by Contractor to benefit the health, safety and welfare of persons or property, including, but not limited to, any workplace drug-free programs required by state or federal law. However, nothing contained herein shall relieve Subcontractor of its obligations of implementing its own safety program and of its responsibilities towards its employees, and lower tier contractors. Subcontractor shall review and become knowledgeable about the program which has been made and remains available to Subcontractor for review. Subcontractor shall include the provisions of this paragraph in every lower tier subcontract, and shall require its subcontractors to include it in their subcontracts so that such provisions will be binding upon each subcontractor and its employees, at every tier. In the event of Subcontractor's noncompliance, this Subcontract may be canceled, terminated, or suspended, in whole or in part, at the Contractor's sole election. A complete copy of the Program will be made available by Contractor upon request.

7. Subcontractor shall furnish all tools, equipment, scaffolding, hoisting equipment, apparatus, ways, machinery and plant necessary to perform the Subcontract Work.

8. Subcontractor shall timely provide and pay for all engineering, testing, surveying, special inspections and instrumentalities as may be required by Owner or Contractor in connection with the performance of this Subcontract. Should Subcontractor fail to accomplish the foregoing on a timely basis, Contractor may perform said task and charge the account of Subcontractor for same.

9. Subcontractor shall employ no person whose employment on or in connection with this Project may be objectionable to Contractor, and shall discharge any such person when objected to by Contractor, provided that this shall not require Subcontractor to violate any law, governmental regulation or collective bargaining agreement.

10. Subcontractor consents to Contractor’s assignment of this Subcontract at any time. In the event of such
assignment, Subcontractor shall perform all of its obligations under this Subcontract for the assignee and Contractor shall have no further obligation to Subcontractor for matters arising out of future performance thereof.

11. Subcontractor shall provide continuous supervision utilizing a field supervisor competent and knowledgeable about the specific nature of this throughout the duration of the Subcontract Work. Contractor reserves the right of approval of Subcontractor’s supervisory staffing assignments and revisions thereto. Subcontractor shall notify Contractor (10) days in advance of any proposed supervisory staffing revisions. Any supervisory staffing revision implemented without proper notification and approval may result in a $500.00 charge per occurrence against Subcontractor’s account.

12. Subcontractor shall be present at and participate in all scheduled project meetings and any additional meetings deemed necessary by Contractor to properly coordinate the Project.

13. Subcontractor shall not assign the whole nor any part of this Agreement and/or Subcontractor's Work without prior written approval of Contractor.

14. Subcontractor certifies that it now maintains and at all times during performance of this Subcontract shall maintain (1) a valid certificate of registration; (2) a current unified business identifier number; (3) state industrial insurance coverage as required in Title 39 Chapter 71 MCA; (4) an employment security department number as required by Title 39 Chapter 51 MCA; and (5) a State excise tax registration number as required in Title 15 MCA. Subcontractor further certifies that it has never been disqualified from bidding or performing work because of a lack of a valid certificate of registration or prevailing wage violation within the last 5 years. Subcontractor shall verify and cause compliance by any lower tier subcontractor with the requirements of this paragraph.

15. When the Contract Documents require design-build services for performance of the Subcontract Work, Subcontractor shall provide design services through a licensed design professional so that the Subcontract Work is in strict accordance with the requirements of the Contract Documents. Subcontractor shall coordinate its design services and construction work with the requirements of Owner and Contractor and the work of other subcontractors so as to provide a complete design and construction of the Subcontract Work that will properly interface, will be fully compatible, and will properly function in accordance with the requirements of the Contract Documents. The standard of care for architectural and engineering services performed under this Subcontract Agreement shall be the highest degree of care and skill used by members of the architectural and engineering professions practicing under similar conditions at the same time and locality.

B. LAWS AND REGULATIONS

1. Subcontractor shall comply with all applicable federal, state, county, municipal and local laws, codes, ordinances, rules, regulations, standards, orders, notices and requirements, including those relating to hazard notification, OSHA or other safety requirements, HIPAA regulations, fair employment practices, prevailing wage, equal opportunity, and discrimination on the basis of race, religion, sex or national origin (hereinafter “Laws”), without additional expense to Contractor. Subcontractor shall correct, at its own cost and expense, any violations thereof. Subcontractor shall require its suppliers and lower tier subcontractors to also comply with this requirement, and shall furnish such proof as Contractor may request to demonstrate compliance with such Laws.

2. All work, labor, services and materials to be furnished by Subcontractor must strictly comply with all applicable Laws now in force and hereafter placed in effect without any additional compensation.

3. Subcontractor agrees to defend, indemnify and save Contractor, its surety, if any, and Owner harmless from and against any and all claims, loss, fines, penalties, or expense, including attorney fees and costs, caused directly or indirectly by its failure to fully comply with any Laws or provisions of this Agreement. Subcontractor shall not settle or otherwise resolve any matters tendered to Subcontractor by Contractor, without the express written consent of Contractor.

4. Subcontractor shall pay all royalties and licensee fees, and further agrees to defend all suits or claims for infringement of any patent rights involved in the Subcontract Work, and further agrees to hold Contractor harmless from loss, cost or expense on account of such use or infringement by Subcontractor.

C. INSURANCE AND BOND

1. Subcontractor shall provide all insurance which strictly complies with the requirements of Appendix 2.

2. If paragraph 2, on page 2 of the Subcontract Agreement, requires Subcontractor to supply bonds for this project, then Subcontractor shall at its own expense furnish Contractor, within ten (10) days of receipt of this
Subcontract, performance and payment bonds in a form and from a surety acceptable to Contractor in amounts equal to the sum of the Subcontract Price, approved change orders and applicable tax. The bonds shall be conditioned upon the full and faithful performance of all terms, provisions, and conditions of this Subcontract, and specifically upon payment for all labor, materials, equipment and supplies used in the prosecution of the Subcontract Work. If paragraph 2 does not require bonding, then Subcontractor shall only be required to provide the bonds described above within ten (10) days of receipt of a request therefore, and Contractor shall reimburse Subcontractor for reasonable bond premiums that result. The terms of this Subcontract Agreement are expressly incorporated into the terms of the bond(s). The provisions of such bond shall not conflict with the express terms and rights of the Contractor under this Subcontract and any such conflicting or inconsistent bond terms are hereby superseded by the terms of this Subcontract.

D. **SUBMITTALS, O&M MANUAL, AS BUILTS**

1. Subcontractor agrees to furnish Contractor complete and accurate shop drawings, specifications, final selection of materials, and other specified items in quantities required by Contractor for approval by Owner or Owner’s agents sufficiently early so as to prevent delay to the progress of the Project.

2. Subcontractor agrees to furnish Contractor complete operational and maintenance manuals, as built, and spare parts in such quantities and format as may be required by the Main Contract or the Contractor. Delivery to Contractor shall be prior to Subcontractor’s substantial completion, and sufficiently early so as to prevent delay to the completion of the Project.

3. Notwithstanding the dimensions in the Main Contract it shall be the obligation and responsibility of Subcontractor to take such measurements as will insure the proper matching and fitting of the Subcontract Work with all contiguous work. Should Subcontractor request or leave it to Contractor to take such measurements, the ultimate responsibility for the accuracy of these measurements shall be borne by Subcontractor.

E. **LOWER TIER CONTRACTORS**

Prior to commencing performance of any obligation herein, Subcontractor shall list, in writing to Contractor, all lower tier subcontractors and suppliers it intends to use, subject to Contractor’s approval, which approval shall not be unreasonably withheld, and which approval shall not subsequently change such lower tier subcontractors without Contractor’s prior written approval. Subcontractor shall bind all lower tier subcontractors and suppliers to Subcontractor in the same manner as Subcontractor is bound to Contractor, and as Contractor is bound to Owner. Please refer to Appendix 5 – Subcontractor & Major Supplier Affidavit for the reporting form.

F. **NATURE OF WORK**

1. Subcontractor has carefully examined and understands the Main Contract; has satisfied itself as to the nature and location of the Subcontract Work, the character, quantity and kind of conditions to be encountered, and the character, kind and quality of the equipment needed to prosecute the Subcontract Work; has visited and familiarized itself with the location, conditions and other matters visible at the job site which can in any manner affect the Subcontract Work; and here acknowledges it has had reasonable opportunity to complete same. Subcontractor accepts this Subcontract on the basis of the foregoing, and not in reliance upon any opinion or representation by Contractor or others.

2. Prior to commencing, Subcontractor shall notify Contractor in writing of any conditions which might adversely affect its work; failure to do so shall constitute a waiver of entitlement to any additional compensation or contract time arising out of such conditions.

3. Subcontractor shall regularly check the correctness of all work installed by others which may affect Subcontractor’s Work. Subcontractor’s failure to promptly detect or report discrepancies to Contractor before proceeding shall preclude Subcontractor from recovery for any resulting cost, expense or damage.

G. **SCHEDULING/TIME OF COMPLETION**

1. Time is of the essence in this Subcontract.

2. Subcontractor acknowledges and is bound to the substantial completion date, as well as the final completion date for the entire Project in accordance with the Main Contract, Contractor’s schedule, and Appendix 1. Subcontractor agrees that all necessary costs to meet these required completion dates are included in the Subcontract Price and that no time extensions will be granted under any circumstances except as may be granted by the Owner.

3. Subcontractor shall promptly provide Contractor with any requested scheduling information, including periodic projections of its anticipated progress on the Subcontract Work and anticipated delivery dates for materials or equipment that may be in the course of preparation or manufacture. Contractor shall accept input from Subcontractor regarding developing and updating the
construction schedule, but retains the right to decide the time, order and priority in which the various portions of the Project shall be performed. Contractor reserves the right to modify the sequence of Subcontractor’s activities as the process warrants with no additional compensation to Subcontractor. Contractor shall make the schedule and any revisions thereto available to Subcontractor for review.

4. Subcontractor is responsible for review of original schedule and periodic updates to confirm that duration and sequencing is reasonable and attainable. Failure to notify Contractor within five (5) days of Subcontractor’s receipt of original and updated schedules constitutes acceptance of the current schedule.

5. Contractor shall give Subcontractor advance notice of the anticipated starting date for Subcontract Work. Subcontractor shall start the Subcontract Work on the date established by Contractor, and shall complete it at such times as may be scheduled or rescheduled by Contractor.

6. Subcontractor shall perform the Subcontract Work as directed by Contractor in a manner that, in Contractor’s opinion, benefits the overall Project schedule. Subcontractor agrees to cooperate with and coordinate its efforts with Contractor and other subcontractors whose work may interfere with the Subcontract Work. Subcontractor shall participate in the preparation of coordination drawings and work schedules as may be required by Contractor in areas of congestion, specifically advising Contractor in writing of any interference by others within twenty-four (24) hours of discovery. Should Subcontractor fall behind, it shall take necessary action to meet and maintain job progress without additional compensation, and shall be liable to and reimburse Contractor for damages resulting from or related to any delay, including, but not limited to, overtime and off-hour supervisory costs incurred by Contractor and by any of its other Subcontractors resulting from or relating to such delay.

7. Subcontractor shall comply with any written instructions given by Contractor, including instructions to suspend, delay or accelerate Subcontract Work.

8. Subcontractor assumes the responsibility to pay Contractor such liquidated damages as may be assessed against Contractor under the Main Contract for delays related to Subcontractor’s work. Subcontractor shall pay such damages directly or by offset to the extent any delay is caused, in whole or in part, by Subcontractor or those third parties contracting with Subcontractor, which payment shall be in addition to any other claim Contractor may have for actual damages caused by Subcontractor's delay.

9. Contractor shall establish the normal business hours on the Project. No work shall be allowed at the Project site outside of normal business hours without first securing the express written permission of Contractor. Any work permitted outside of normal working hours shall be approved via a unilateral change order only, and is subject to the following terms and conditions: (a) No work outside of normal business hours shall be performed without Contractor's supervision. Subcontractor shall compensate Contractor for Contractor's supervisor's time spent supervising Subcontractor's outside of-hours performance. (b) Upon demand by Contractor, Subcontractor shall compensate Owner for any additional inspection costs incurred by Owner as a result of outside of-hours performance. (c) At the sole option of Contractor, Contractor may allocate the costs detailed in (a) and (b) above among two or more subcontractors. (d) The issuance of an outside of-hours change order is at the sole discretion of Contractor. Contractor may terminate that change order at any time. Such termination shall not create a cause of action in Subcontractor against Contractor and Subcontractor acknowledges it shall retain no right to continue to work after-hours thereafter.

10. Subcontractor shall abide by Contractor’s decision as to allotment of all storage and working space on the Project.

H. MATERIALS AND EQUIPMENT

1. Materials and equipment delivered to the job site by or for Subcontractor shall remain on the job site and shall become the property of Owner upon payment therefore. It shall be Subcontractor’s responsibility to unload, store and protect the materials and equipment it furnishes, and Subcontractor shall bear the risk of loss or damage thereto. Subcontractor shall protect such materials and equipment against loss until they are actually incorporated into the Project and the Project is finally accepted by Owner, even though title thereto may previously have passed to Owner, except that Subcontractor shall not bear the risk of any such loss as may be due to the sole negligence of Contractor.

2. Subcontractor may only use Contractor’s tools or equipment after first obtaining prior approval from Contractor. Contractor makes no express or implied warranties with respect to the condition or fitness of said equipment and any such warranties are expressly disclaimed. Subcontractor’s use shall constitute an express agreement to rent said tools or equipment at the then prevailing rate as set forth in the current Rental Rate Blue Book. Subcontractor is responsible for complying with all laws and regulations and payment of any penalties or fines resulting from the use of same. Subcontractor shall be
solely liable for and shall indemnify, defend and hold Contractor harmless from any damage to, and arising from the use of, such equipment while under Subcontractor’s control.

I. PAYMENT

1. Prior to its first application for payment and as a condition of payment, Subcontractor shall submit to Contractor the following:

   a. A schedule of values in sufficient detail and in a form and format acceptable to the Contractor for use in checking Subcontractor’s monthly progress;

   b. If this Subcontract is governed by prevailing wage laws, intent to Pay Prevailing Wages must be filed with the applicable agency. No pay requests will be processed until the completed form has been approved by the state or federal agency, where applicable;

   c. A list of material suppliers, vendors for equipment rental, and subcontractors to be utilized on the Project. This list shall contain the name, address, phone and fax numbers, a description of the materials and services to be provided, and the anticipated contract amount for each subcontractor/supplier;

   d. For work in Washington State, Subcontractor shall furnish Contractor a Premium Status report issued by the Washington State Department of Labor and Industries, in respect to Subcontractor’s account with the Department of Labor and Industries;

   e. A certificate of insurance and endorsements in full compliance with Appendix 2 – Insurance;

   f. A fully executed Subcontract Agreement.

2. For each and every application for payment, Subcontractor shall submit to Contractor the following:

   a. A fully executed and approved “Application for Payment” form and approved schedule of values reflecting progress during the contractual reporting period;

   b. Subcontractor’s fully executed and unmodified “Lien/Claim Release” form;

   c. If necessary, an updated list of subcontractor’s vendors or subcontractors if substitutions or additions are made, or costs have changed from the originally submitted form;

   d. If requested by Contractor, Subcontractor shall provide Contractor’s “Application for Payment” and “Lien/Claim Releases” for each of its lower tier subcontractors and suppliers.

   e. If requested by Contractor, Subcontractor shall provide proof that Subcontractor is current in its required contributions with any union, public or private trust, health and welfare plan, pension plan, state or federal prevailing wage contribution requirements or the equivalent.

3. Subcontractor shall be paid for its work up to the date Contractor’s last approved progress billing, provided seven days have elapsed following the date when Contractor receives its payment for such progress billing. Contractor and Subcontractor expressly agree that Subcontract’s full compliance with the requirements of this Agreement is a precondition to any payment falling due.

4. Final payment to Subcontractor, subject to withholding as permitted hereunder, shall not be due until:

   a. Both Subcontractor’s Work and the entire Project have been accepted by Owner;

   b. Seven (7) calendar days have passed following the time when Contractor has been paid in full;

   c. Proof of payment, in a form satisfactory to Contractor and Owner, of all amounts owed by Subcontractor in connection with this Subcontract has been provided, including conditional lien and claim waivers, releases and affidavits;

   d. All other payment prerequisites in this Subcontract and the Main Contract have been satisfied.

5. To the extent the Main Contract provides for early acceptance (prior to completion of the entire Project) of portions of the Main Contract work, and for release of retainage pertaining to such work at the time of such acceptance, and provided Owner elects early acceptance and makes full payment for the Subcontract Work or any portion thereof, and paragraphs 1-3 above have been satisfied, then final payment to the Subcontractor shall be similarly accelerated.

6. Subcontractor’s applications for payment for work and materials incorporated into the Project shall be for such quantities as may be determined by Contractor or Owner, shall be in Contractor’s home office in proper form by the twenty-fifth day of each month noted in order to be considered for that month’s payment. The schedule of values shall be used for payment purposes only, and approval of an application for payment shall not relieve
Subcontractor from furnishing all work and performing all other obligations required by this Subcontract.

7. If the Main Contract permits payment for materials delivered to the jobsite or to satisfactory storage facilities, Subcontractor may invoice for materials so delivered and receive payment therefore as outlined herein; provided however, that all such stored materials shall be stored at the sole risk and expense of Subcontractor until final acceptance of the Subcontract Work. As a condition of payment, Subcontractor shall provide a bill of sale for such material in a form approved by Contractor and specifically identifying the material in question. Subcontractor shall segregate and label the material with identifying markings indicating the materials are held for Contractor and shall provide proof of the same upon request of Contractor. Subcontractor shall also provide proof of insurance, subject to Contractor’s approval, for such materials including insurance for warehouse or bonded warehouse, and insurance in transit.

8. Subcontractor agrees that its rights to payment, if any against Contractor and its surety, are strictly governed by the terms of this Subcontract, notwithstanding any additional rights that may be granted to Subcontractor by any statute, including but not limited to the Federal Miller Act or any state bond act.

9. If required, Subcontractor shall submit certified payrolls in the form acceptable to Contractor. No pay requests will be processed until the completed forms have been approved by the state or a federal agency, where applicable.

10. Contractor may withhold retainage from Subcontractor in the same percentage as Owner withholds retainage from Contractor or in an amount not to exceed five percent (5%) of the money earned by the Subcontractor, whichever is greater, as a trust fund for the satisfactory completion of the Subcontract Work. Unless otherwise provided by applicable law, the retainage will not accrue interest. The retainage will be released to Subcontractor upon the later of 60 days after final completion of the Contractor's Work, final acceptance by the Owner, or Contractor's receipt of retainage from the Owner.

11. Signature by Subcontractor on periodic lien and claim waivers constitutes an agreement by Subcontractor to indemnify, defend, and hold Contractor, its surety, the Owner, and the Project harmless from any claim which arises out of or is related to labor, services, material or equipment covered by the applicable lien and claim waiver and which is asserted by Subcontractor or by a lower tier supplier, vendor, laborer, subcontractor, or other person who may have rights to assert a claim against Contractor’s bond or a lien against the property.

12. Owner's payment to Contractor for the Subcontractor's account is an absolute condition precedent to Contractor's obligations to make progress or final payment to the Subcontractor under this Subcontract. Subcontractor expressly agrees to bear the risk of the Owner’s non-payment. Subcontractor is relying on the credit of Owner, rather than Contractor, for payment of its efforts.

13. Subcontractor, its officers, directors and owners shall act as a fiduciary for Contractor and Subcontractor’s employees, lower tier subcontractors, and suppliers on the Project and all progress payments shall be considered trust funds intended to be held in trust to pay those parties all sums owing to them for work, materials, equipment, labor or other obligations of Subcontractor related to the Project, before paying itself any remaining funds. Subcontractor hereby grants Contractor a security interest in Subcontractor’s accounts receivables to secure Subcontractor’s obligations hereunder.

14. If it appears Subcontractor is not promptly paying its bills in this fashion, if Subcontractor assigns or otherwise factors its accounts receivables, or if Contractor has any other grounds for concern, Contractor may take such steps as it deems necessary to insure that progress and final payments are utilized to pay such bills, including but not limited to the issuance of third party or two party checks.

15. Progress payments are advances subject to adjustment at any time for errors, overpayment, faulty or defective work or material, or Contractor’s good faith determination that the remaining balance of payments may be insufficient to insure completion of the Subcontract Work in accordance with its terms. Should the remaining unpaid Subcontract balance become insufficient to cover completion costs at any time, Subcontractor and its sureties, if any, shall promptly reimburse Contractor for such overpayment.

16. Contractor may withhold amounts otherwise due under this Subcontract, or under any other arrangement between the parties, as an offset to cover 150% of Contractor's reasonable estimate of any liability Contractor has incurred or may incur for which Subcontractor may be responsible under this Subcontract, or under any other agreement between the parties. This offset shall be subject to adjustment when the exact amounts of liability are determined, but in no event shall the amounts withheld bear interest.

17. Subcontractor shall notify Contractor in writing of any intention to assign the proceeds of this Subcontract prior to
such assignment, and Subcontractor shall provide Contractor with the written acceptance by Assignee of the terms of this Subcontract, and of the obligations for adjustment and offset, before such assignment shall occur or be honored. It is agreed that the assignee of funds due or to become due under the Subcontract shall take such assignment subject to the trust fund obligations of Subcontractor and all other obligations of Subcontractor to Contractor, with respect not only to the Subcontractor's work under this Subcontract, but also with respect to any other Subcontract Work performed by Subcontractor for Contractor on other Projects.

J. UNIT PRICE

In the event this Subcontract contains unit price items, it is understood and agreed that any quantities mentioned are approximate only, are based upon information furnished by Owner, and are subject to change as required by the Main Contract and as ordered and directed by Contractor. Price adjustments, if any, for variations in quantity are available to Subcontractor only if they are available to Contractor under the provisions of the Main Contract, and then only proportionate to any adjustment actually obtained by Contractor from the Owner.

K. CHANGES IN THE SUBCONTRACT WORK

1. Contractor shall have the right by written order, to direct changes, additions, deletions, or alterations to the Subcontract Work or the time of performance. Contractor shall have this right without notice to Subcontractor's surety, if any. Should Subcontractor claim any such order or any act by Contractor or others would cause additional costs, or if Subcontractor otherwise believes it is entitled for any reason to an adjustment in the Subcontract Price or Subcontract time, Subcontractor shall submit written notice to Contractor within seven (7) calendar days of said claim arising, and prior to commencing such work; otherwise, such claim shall be deemed waived, and Subcontractor shall have no right to maintain an action in court or arbitration to recover for extra work. In no event shall Subcontractor be entitled to a change order or an equitable adjustment unless authorized in writing by Contractor. Should the parties be unable to agree as to the value of any work to be added, deleted or altered, Subcontractor shall proceed with the work promptly, but only upon written order of Contractor, and the amount due for the disputed work shall be resolved as provided, in this Article and pursuant to Article T.

2. The value of any work added, deleted or altered from the Subcontract Work shall be determined by one or more of the following methods, or combinations thereof, as Contractor may elect: (1) mutual acceptance of a lump sum with properly itemized costs; (2) unit prices established in this Subcontract or subsequently agreed upon (unit prices shall be deemed to include an allowance for all of Subcontractor's direct or indirect costs, including, without limitation, office and shop expense, overhead, profit and bond); or (3) the actual field costs necessarily incurred in the proper performance of the work. “Actual field costs” are defined as actual wages paid for labor in the direct employ of subcontractor plus actual payroll markup to cover all overhead items; the net cost of all subcontracts, materials, supplies or equipment; third party rental charges; plus an allowance for overhead and profit as defined in paragraph K.3 below.

3. Subcontractor’s markup for overhead and profit shall be limited to the lesser of (i) allowances for overhead and profit as stated in the Main Contract or (ii) 5% for work performed by lower tier subcontractors and 10% for work of Subcontractor. This allowance for overhead and profit shall compensate Subcontractor for all costs of any kind attributable to direct and indirect delay, acceleration, or impact and for all noncraft labor, temporary construction facilities, engineering, estimating and home office costs, insurance, B&O taxes, or additional overhead because of extended time and any other cost incidental to the change in the work.

4. Contractor shall not be liable to Subcontractor for any damages or additional compensation as a consequence of delays caused by any person not a party to this Subcontract unless Contractor has first recovered the same on behalf of Subcontractor from said person, it being understood and agreed by Subcontractor that apart from such a recovery from said third party, Subcontractor's sole and exclusive remedy for delay shall be an extension of the Subcontract time.

5. Subcontractor acknowledges that, unless expressly stated otherwise within a written change order, any change in the Subcontract Price and time affected through a written change order shall constitute full payment and accord and satisfaction for all costs incurred, labor performed, material and equipment furnished, and any delay, acceleration, or loss of efficiency associated with the change in the work, as well as for any schedule extensions that might be warranted.

6. Contractor shall have the right to inspect, copy and audit the books and records of Subcontractor or any lower tier subcontractor or supplier making claim for reimbursement for actual costs in order to verify the claim accuracy and to determine if costs claimed will be allowed.

L. PERMITS/TAXES
1. The Subcontract Price includes, and Subcontractor accepts exclusive responsibility for securing and paying for: (1) all permits, fees and licenses necessary for the performance of the Subcontract Work; (2) all federal, state, county, municipal and other taxes, including without limitation business and occupation taxes, personal property taxes, sales taxes, use taxes, penalties and interest, based upon labor, services, goods, equipment or other items acquired, performed, furnished or used in connection with the Subcontract Work; (3) paying any contributions, taxes or premiums, including penalties and interest, measured upon Subcontractor's payroll or required to be withheld from Subcontractor's employees; and (4) paying any pension, welfare, vacation, annuity and other benefit contributions owed in connection with labor agreements or applicable law.

2. Subcontractor shall apply for all required permits within ten (10) days of execution of this Subcontract. Subcontractor shall submit evidence of permit issuance to Contractor prior to the first payment to Subcontractor being considered due and payable.

M. EMPLOYEE-RELATED PAYMENTS

1. Subcontractor has the status of employer as defined by Industrial Insurance, the Workers' Compensation and Unemployment Compensation Acts, Social Security, and other similar laws, rules and regulations of the federal, state and local government. Subcontractor shall withhold from its payroll applicable social security taxes, workers' compensation, and unemployment compensation contributions and withholding taxes and timely pay same, and Contractor shall in no way be liable as an employer to or on account of any of the employees of Subcontractor.

2. Before final payment is made upon this Subcontract, Subcontractor shall furnish evidence satisfactory to Contractor that it has conformed and shall conform to said laws, rules and regulations. Subcontractor hereby agrees to indemnify Contractor for any and all liability arising from the Subcontract Work related to such laws.

N. INSPECTION AND DEFECTIVE WORK

1. Subcontractor shall at all times provide sufficient, safe and proper facilities in the field, at shops, or at any other place where materials or equipment for the Subcontract Work are in the course of preparation, manufacture, treatment or storage, for inspection by Contractor or Owner or their authorized agents.

2. Within twenty-four (24) hours after receiving written notice from Contractor to that effect, Subcontractor shall proceed to take down all portions of the Subcontract Work, and remove from the jobsite all materials, whether worked or unworked, which the Owner or Contractor shall condemn as unsound, defective, or in any way failing to conform to this Subcontract or the Main Contract. Subcontractor, at its own cost and expense, shall replace the same with proper and satisfactory work and materials and make good all work damaged or destroyed by or as a result of such unsound, defective, improper or nonconforming work or materials or by the taking down, removal or replacement thereof. Should Subcontractor fail to timely act on Contractor's notification, Contractor shall have the right to remedy such defective work with all associated costs to be charged against Subcontractor's account. Such action by Contractor shall not relieve Subcontractor of any other obligations stated herein.

O. JOB DAMAGE

1. Damage caused by Subcontractor to any work or to Existing Site or Building Improvements shall be reported immediately to Contractor, and Subcontractor shall be responsible for the cost of its repair. Job damage caused by Contractor to the Subcontract Work shall be reported immediately to Contractor in writing and Contractor shall be responsible for its repair.

2. Subcontractor shall promptly and adequately protect its Work in accordance with the Main Contract and any applicable Laws. Subcontractor shall be solely responsible for any damage resulting from its failure to do so.

P. HOUSEKEEPING AND SAFETY

1. Subcontractor shall regularly and promptly, at its own expense, remove all refuse, waste and debris produced by its operation. Subcontractor shall not permit its refuse to interfere with free access to the work site. In the event Subcontractor fails to remedy these cleanup obligations after notification of violation of these requirements, refuse removal may be done by Contractor and charged against the account of Subcontractor.

2. Subcontractor, at its own expense, shall legally dispose of all waste materials off site on a daily basis. Should Subcontractor leave empty boxes or crating on site which are subsequently used by others for waste disposal, Subcontractor will be held responsible for disposal of the boxes and their contents. Contractor will not be responsible for the disposal of Subcontractor's hazardous waste and will not provide a dumpster for Subcontractor's use.

3. Subcontractor shall provide all necessary employee training and shall manage, accumulate, transport and dispose all regulated hazardous waste generated by
Subcontractor during its work in accordance with national, regional and local requirements.

4. Subcontractor shall conduct the Subcontract Work in a safe manner, shall comply with all safety measures initiated by Contractor or required by the Main Contract, and shall comply with all Laws relating to the safety of person or property. Subcontractor accepts responsibility to prevent accidents to workmen engaged upon or in the vicinity of the Project. Subcontractor shall be solely responsible for the protection and safety of its employees, for final selection of additional safety methods and means, and for daily inspection of its work area and safety equipment. When so ordered, Subcontractor shall stop any part of the Subcontract Work which Contractor deems unsafe until corrective measures satisfactory to Contractor have been taken, and the Subcontractor agrees it shall not have or make any claim for damages growing out of such stoppages. Should Subcontractor fail to take such corrective measures, Contractor may attempt to remedy the condition at the cost and expense of Subcontractor and may deduct the cost thereof from any payments due or to become due Subcontractor. Failure on the part of Contractor to stop unsafe Subcontractor practices shall in no way relieve Subcontractor of its responsibility hereunder.

**Q. WARRANTY AND INDEMNITY**

1. Subcontractor warrants the Subcontract Work and materials furnished hereunder to Contractor and Owner on the same terms, and for the same period, as Contractor warrants the work to Owner under the Main Contract. With respect to the Subcontract Work, Subcontractor shall assume all warranty obligations and responsibilities of Contractor under the Main Contract. Without limiting the preceding sentences, this warranty shall run at least one year from the Owner's final acceptance of the Project. In no event shall Subcontractor's obligation in this regard be less than the obligation to promptly correct improper or defective Subcontract Work or materials discovered within one year from the date of final acceptance of the Project by Owner.

2. Subcontractor agrees to provide any special warranties required under the Main Contract. Subcontractor agrees to indemnify and hold Contractor harmless from any claims, demands, loss or damages, including attorney fees, arising or resulting from or related to any failure of Subcontractor to strictly comply with a term of this Subcontract.

3. Should any corrective work associated with improper or defective Subcontract Work be required, the original warranty shall be extended to its full duration commencing on the date when such corrective work, in Contractor’s opinion, is completed.

4. Subcontractor shall further indemnify, hold harmless and defend Contractor, Contractor’s surety and Owner pursuant to Appendix 3 hereto. As to any claims subject to the indemnification obligations set forth in Appendix 3 hereto and elsewhere in this Subcontract, Subcontractor agrees to make monthly status reports to Contractor or to Contractor’s designee at Subcontractor’s sole cost and expense. Subcontractor grants Contractor the right to replace Subcontractor’s counsel with counsel of Contractor’s choosing if Contractor reasonably believes Subcontractor is not adequately defending Contractor. Upon such an occurrence, Subcontractor agrees to bear all costs of representation by Contractor’s counsel.

5. Subcontractor shall remove or cause to be removed any and all liens, bond claims or retainage claims of lower tier Subcontractors, suppliers, or laborers before any action is brought to enforce the same, or within ten (10) days after written demand by Contractor, whichever first occurs. Subcontractor agrees to indemnify, defend and hold Contractor, Contractor’s surety, Owner and the Project free and harmless of all liability for any and all such liens or claims, together with attorney fees and costs and expenses related thereto. Without limitation as to any such liens or claims, upon the written request of Contractor, Subcontractor shall post the cash deposit or bond provided for in any applicable statute that permits a construction lien to be “bonded off” real property. If Subcontractor fails to remove or bond off such liens or claims, all expenses, including attorney fees and costs, so incurred by Contractor in doing so, shall be immediately due from Subcontractor to Contractor and shall bear interest at twelve percent (12%) per annum.

**R. FAILURE TO PERFORM**

1. If for any reason Subcontractor fails to start the Subcontract Work as requested by Contractor, or at any time refuses or fails to supply sufficient properly skilled workmen, proper material of the proper quality, or fails or becomes unable in any respect to prosecute timely or satisfactorily complete the Subcontract Work, or commits any other breach of this Subcontract, it shall be deemed in material breach of this Subcontract. In such event, the Contractor without prejudice to any other rights or remedies, may do all or any portion of the following: (a) Contractor may provide any labor and material which in Contractor's opinion are necessary to prosecute, and satisfactorily complete the Subcontract Work by whatever method Contractor deems expedient, including the hiring of another subcontractor or subcontractors, and deducting the cost thereof, including Contractor's overhead,
administrative expenses, and profit margin thereupon, from any payment due or thereafter to become due to Subcontractor; (b) Contractor may withhold further payments to Subcontractor until the Subcontract Work is accepted by the Owner; (c) Contractor may declare the Subcontractor to be in default of the Subcontract and terminate Subcontractor's right to proceed with the Subcontract Work or any part thereof, and prosecute the remaining work as provided above. This termination shall be effective upon three (3) calendar days' notice, without any further notice required; (d) Contractor may, for the purposes of prosecuting and completing the Subcontract Work, take possession of and use without cost all material, equipment and tools belonging to or under the control of Subcontractor. In that event, Contractor shall not be liable for the cost of depreciation nor for any damage occurring during reasonable use. (e) Contractor may pay any bills Subcontractor incurred performing Subcontract Work, and write a unilateral deductive change order therefore.

2. Subcontractor hereby assigns to Contractor, as security for Subcontractor's performance hereunder, all lower tier subcontracts and all other contracts, purchase orders, equipment leases and other agreements entered into in connection with the Project, and appoints Contractor its attorney in fact to enforce said contracts according to their terms. Such assignment shall be operative only upon notice by Contractor and only with respect to those specific agreements designated by Contractor at the time of such notice, in the event of default by, or upon the termination of, the Subcontractor under this Subcontract. All lower tier subcontracts and other such agreements shall provide that the lower tier subcontractor consents to such assignment.

3. Neither the exercise nor non-exercise of Contractor's rights under this paragraph shall excuse Subcontractor from strict compliance with this Subcontract, nor prejudice Contractor's rights to recover damages for any material breach of Subcontractor or to pursue any other remedy that may be available to Contractor.

4. All charges by Contractor against the account of Subcontractor shall include any associated direct costs incurred by Contractor plus a markup of 15% for overhead and profit.

S. CONVENIENCE TERMINATION

Contractor may terminate this Subcontract, or a part of the Subcontract Work, without Subcontractor being at fault, for Contractor's convenience, and require Subcontractor to immediately stop said terminated work. If there has been a termination of the Main Contract by the Owner, the Subcontractor shall be paid the amount due from Owner to Contractor for the Subcontract Work as may be provided for in the Main Contract, less Contractor’s markup, upon such payment by the Owner to the Contractor. Otherwise, Contractor shall pay Subcontractor for that work actually performed prior to termination in an amount proportionate to the Subcontract Price. In the event of such a convenience termination, Contractor shall not be liable to Subcontractor for any other costs or amounts, including prospective profits or unabsorbed overhead on Subcontract Work not performed.

T. DISPUTES

1. All claims, disputes or other matters in question shall be resolved in strict accordance with the following provisions:

   a. Pass through Claims:

   In the event that a claim, cause of action, dispute, or other matter in question is asserted by Subcontractor against Contractor but which Contractor, in its sole discretion, asserts is the responsibility of the Owner, the Architect, or their agents or representatives or is asserted by Owner against Contractor but which Contractor in its sole discretion, asserts is the responsibility of Subcontractor (hereinafter “pass through claim”), Subcontractor agrees that the dispute shall be resolved in accordance with any and all dispute resolution procedures in the Main Contract and Subcontractor shall be bound to Contractor to the same extent as Contractor is bound to those procedures and to any associated rights and remedies as provided in the Main Contract.

   b. Matters under $250,000:

   Except as provided herein, all claims, counterclaims, disputes, and other matters in question between Contractor and Subcontractor which are less than $250,000 (exclusive of interest and attorneys fees) and which arise out of or relate to the Main Contract or this Subcontract, any breach thereof, or any work thereunder shall be decided by arbitration before one arbitrator in accordance with the then-current Construction Industry Arbitration Rules of the American Arbitration Association. This Arbitration provision shall not apply if the Contractor in its sole discretion determines that (i) complete and full relief cannot be granted by an arbitrator, (ii) if necessary or proper parties cannot be named in the arbitration, (iii) any claim, counterclaim, dispute or other matter in question between Contractor and Subcontractor exceeds $250,000 irrespective of the size of any other claim or dispute, or (iv) if Contractor determines that some or part of a Subcontractor’s claim is a “pass through claim” as defined in paragraph 1(a).
c. All other matters:

All other claims, causes of action, disputes or other matters in question which are not eligible for or subject to arbitration or dispute resolution under the Main Contract shall be resolved by litigation. The exclusive forum for and venue of such litigation shall be the District Court, Missoula County, Montana. If any such litigation is within the sole jurisdiction of the United States Federal Courts, then the exclusive forum for and venue of such litigation shall be with the United States District Court for the District of Montana.

2. In the event of a dispute as to the applicable dispute procedure under paragraphs 1(a)-(c), the Contractor shall have full discretion to determine the applicable procedure or exception and that decision shall be final and binding on Subcontractor.

3. As between the parties to this Subcontract, the prevailing party in any litigation, or arbitration, shall be entitled to an award of its attorney fees and costs incurred. Contractor and Subcontractor expressly grant any arbitrator the authority to award attorney fees and costs. The parties also agree that in any action to confirm the arbitration award or in any post-arbitration court proceeding, the court shall award the prevailing party its attorney fees and costs.

4. In the event of arbitration under paragraph T.1(b), the arbitrator shall be chosen from the AAA's List of Neutrals residing in the State of Montana. The venue and location of all arbitration hearings shall be in Missoula, Montana. The Montana State statutes of limitations, statutes of repose, and the doctrine of laches shall apply to any Arbitration proceedings. Subcontractor agrees that Contractor at its sole election, may join other parties including, without limitation, Subcontractor’s surety, if any, in said arbitration and they further agree to be bound by the findings and award of such arbitrator without recourse to any court of law other than for enforcement of the arbitrator’s decision. Contractor may at its sole election, consolidate any dispute or Arbitration governed by this agreement into any other arbitration, dispute or lawsuit in which the Contractor may engage or be engaged. Any dispute over the arbitrability of any claim or the consolidation of claims and parties shall be decided by a court of competent jurisdiction, rather than by any arbitrator.

5. In the event of a pass through claim as defined in paragraph T.1(a) or other claim, cause of action, dispute or matter in question asserted by Subcontractor against Contractor but which Contractor, in its sole discretion, asserts is the responsibility of any other subcontractor, or supplier, or other participant of the Project (“third party”), Subcontractor agrees as follows:

a. to be bound to any findings, determinations, or awards made under the dispute resolution procedures of the Main Contract, or by an administrative agency, board, court of competent jurisdiction, or arbitration, and to any and all appeals therefrom, whether or not Subcontractor is a party to the proceedings;

b. to cooperate fully with Contractor and to furnish all documents, statements, witnesses, and other information required by Contractor if any dispute or claim involving the Subcontract Work is prosecuted or defended by Contractor, and Subcontractor is not a party to that proceeding, and Subcontractor further agrees to pay or reimburse Contractor for all expenses and costs, including reasonable attorney fees incurred in connection therewith, to the extent of Subcontractor's interest in such claim or dispute;

c. Contractor shall not be liable to Subcontractor therefore in any greater amount than Owner or third party is liable to Contractor, less any markups or costs incurred by Contractor;

d. to not take, and to suspend and stay if already undertaken, any other action or actions with respect to any claims, and to pursue no independent litigation or arbitration with respect thereto pending final determination of any dispute between Owner or third party and Contractor; and

e. at the sole option of Contractor, to prosecute any claim in the name of Contractor that Contractor contends in whole or in part is based on or arises out of any breach, action or omission of the Owner, Owner's agents or third party and to pay Contractor fifteen percent (15%) of any amount thereby recovered or collected on behalf of Subcontractor, whether through Court, arbitration proceedings, or settlement in lieu of its standard mark-up for such claims and to take full responsibility for the preparation, presentation, appeal and final disposition of such claims, and shall pay all the expenses thereof including attorney fees.

6. Written notice of any claims whatsoever by Subcontractor shall be given to Contractor the earlier of, immediately upon Subcontractor's first knowledge of the event, or within seven (7) calendar days of becoming aware of the event for which such claim is to be made, whichever is earlier. Otherwise, such claims shall be deemed waived. Subcontractor must serve a demand for arbitration over all such claims no later than one hundred twenty (120) days after substantial completion or the
Subcontractor will be barred from bringing any action (in arbitration or in court) over those claims.

7. Subcontractor agrees to reimburse Contractor for any damages, including Contractor’s attorney fees incurred by Contractor, due to Subcontractor’s failure to strictly adhere to any claims or dispute resolution provisions in this Subcontract, including but not limited to any pass through claims to the Owner or other third parties but which Contractor is unable to pass through because of Subcontractor’s failure to adhere to such claims provisions. Contractor shall be entitled to assert its right of reimbursement acquired hereunder as a set off to any claim of Subcontractor.

8. As a condition precedent to submitting to any trial or arbitration of any claim or counterclaim between Subcontractor and Contractor, the parties to this Subcontract shall first submit their dispute to non-binding mediation with the assistance of a recognized professional mediation service. The parties shall each designate a representative with full settlement authority who shall participate for at least four hours in the mediation. The parties shall bear equally all expenses, exclusive of attorney fees, associated with the mediation.

U. MISCELLANEOUS

1. No modification of this Subcontract and no waiver of any rights under this Subcontract shall be valid or binding on the parties unless the same be in writing signed by both parties.

2. This Subcontract shall be considered to have been made in and shall be interpreted, to the extent permitted by law, under the laws of the State of Montana.

3. Any written notice required to be given to a party shall be hand-delivered or delivered via certified mail to the address of that party indicated above.

4. The partial or complete invalidity of any one or more provisions of this Subcontract shall not affect the validity or continuing force and effect of any other provision. If any provision is invalid, in whole or in part, the balance of the provisions shall be considered reformed to reflect the intent of the parties to the greatest extent possible consistent with the law.

5. The failure of either party to insist, in any one or more instances, upon the performance of any of the terms, covenants, or conditions of this Subcontract, or to exercise any right herein, shall not be construed as a waiver or relinquishment of such term, covenant, condition or right as respects further performance.

6. Termination shall not relieve Subcontractor from obligations in connection with work performed prior to termination, nor shall it abrogate any provisions herein dealing with resolution of disputes.

7. Subcontractor expressly acknowledges and agrees that all of the obligations Contractor owes to Subcontractor are contained in the express written provisions of this Subcontract and that Contractor owes no implied duties or obligations to Subcontractor.

8. This Subcontract represents the final integrated understanding of the parties and shall supersede any prior proposals, offers, negotiations, revisions, unincorporated written communications or oral discussions, statements, representations or agreements.

END OF GENERAL CONDITIONS
APPENDIX 1
Scope of Work

Project Number: ____________________________

Project Name: ____________________________

Cost Code: ________________________________

Subcontractor: ____________________________

This Appendix 1 is hereby made a part of the Subcontract between Contractor and Subcontractor. In addition to the work described in other parts of this Subcontract Agreement, the following further describes Subcontractor's scope of work:

A. SCOPE OF WORK. All work necessary or incidental to complete the Subcontract Work Description Work for the Project in strict accordance with and reasonably inferable from the Main Contract and as more particularly though not exclusively, as specified in: Specification Section(s) [List] and all related sections, and all applicable General Requirements for the Project.

with the following additions and deletions:

Specific Inclusions:

•  {Contract Inclusions Description}

Specific Exclusions:

•  {Contract Exclusions Description}

Special Conditions:

•  {Contracts Notes}

B. 1. LUMP SUM
[List Lump Sum Here]

2. UNIT PRICES
[List Any Unit Prices Here]

C. Subcontractor’s Schedule Requirements
APPENDIX 2

Project Number: 

Project Name: 

Subcontractor: 

Insurance

This Appendix 2 is hereby made a part of the Subcontract by and between Contractor and Subcontractor.

Subcontractor shall comply with the following:

1. **Standard Insurance Coverages:** Subcontractor shall secure and maintain from the earlier of commencement of work or the effective date of the Subcontract the minimum insurance coverages and limits required by this Appendix 2 or if greater, any coverages or limits of liability specified in the Main Contract or required by law. If Subcontractor’s existing policy(s) provides higher limits than those specified below, the higher limits shall apply and the certificates of insurance provided by Subcontractor shall reflect those higher limits. Before permitting any Sub-subcontractor to perform any work under the Subcontract, the Subcontractor shall require that the Sub-subcontractor maintains insurance in like form and amounts to that required herein. Prior to commencing its performance under the Subcontract, Subcontractor shall provide Contractor (i) a certificate of insurance evidencing the coverage required by this Appendix 2 (a sample Certificate of Insurance is attached for reference purposes), and (ii) applicable endorsements required by this Appendix 2.

1.1 **Worker’s Compensation and Employer’s Liability:** Worker’s Compensation Insurance and Employer’s Liability Insurance (including occupational disease) to cover statutory benefits and limits under the Worker’s Compensation laws of any applicable jurisdiction in which the Subcontract Work is to be performed and Employer’s Liability Insurance with minimum limits of one million dollars ($1,000,000) each accident, one million dollars ($1,000,000) for disease, each employee and one million dollars ($1,000,000) disease policy limit.

Policy coverage terms and conditions to include: (1) USL&H – “if any” basis where applicable, (2) Jones Act – “if any” basis where applicable, (3) All states endorsement, where applicable, (4) Employers Liability/Stop Gap Liability if work is performed in the States of Washington and/or Wyoming, (5) For the attainment of Workers Compensation in monopolistic states, coverage must be secured through the state fund of that state, (6) Certificate must clearly identify that coverage applies in the State in which the Project is located.

Owner-operators are required to furnish Worker's Compensation certificates.

1.2 **Commercial General Liability Insurance:** Commercial General Liability Insurance (“CGL”) written on ISO form CG 0001 Edition date 10/01 or equivalent and shall confer a status or contain an endorsement (Form CG 2503 or equivalent) requiring that the general aggregate limit of liability shall apply to this Project. Coverage shall be based on an occurrence form and include hazards of: (a) Construction Operation, (b) Subcontractors and Independent Contractors, (c) Products and Completed Operations applicable to the additional insured (with Completed Operations coverage to remain in force from the date of final completion of the Subcontract Work until the expiration of the statute of repose of the State in which the Project is located).

CGL insurance shall also include: (1) Contractual Liability coverage sufficient to meet the requirements of the Subcontract/Purchase Order (including defense costs and attorney’s fees assumed under contract, which shall be payable in addition to the limit of liability); (2) Personal Injury Liability (with the standard contractual and employee exclusions deleted); and (3) Notice and Knowledge of Occurrence.
If marked as required, Subcontractor’s CGL insurance is also required to provide the following coverages:

<table>
<thead>
<tr>
<th>Required</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Mold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• EIFS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Subsidence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Operations (performed within) 50’ of railroad</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If the Subcontractor’s CGL insurance excludes any of the coverage required by this Appendix, a separate policy and/or endorsement acceptable to Contractor must be obtained and delivered to Contractor.

CGL insurance shall have the following minimum limits of liability, which shall be available to the Project:

<table>
<thead>
<tr>
<th>Each Occurrence</th>
<th>$1,000,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Products-Comp/Op Agg.</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>Personal &amp; Adv Inj</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>General Aggregate</td>
<td>$2,000,000</td>
</tr>
</tbody>
</table>

1.3 **Commercial Auto Liability Insurance:** Commercial Automobile Liability insurance covering all owned, leased and non-owned vehicles used in connection with the Subcontract Work with limits of $1,000,000 combined single limit per accident for bodily injury and property damage. The policy must include coverage for bodily injury, death and property damage arising out of ownership, maintenance or use of any motorized vehicle on or off the site of the Project, and contractual Liability coverage. If hauling of hazardous waste is part of the Subcontract Work, Automobile Liability Insurance with a $1,000,000 combined single limit per occurrence for bodily injury and property damage applicable to all hazardous waste hauling vehicles, and include MCS 90 endorsement and the ISO Form CA 9948 (Pollution Liability Broadened Coverage for Business Automobile). If CGL 12/04 or later edition is provided, the CA0051 1204: Mobile Equipment Subject to Motor Vehicles Laws shall also be provided. This additional endorsement is not required if the 2006 ISO Auto form is provided.

1.4 **Commercial Umbrella Liability Insurance:** Commercial Umbrella Liability Insurance for bodily injury and property damage liability over Subcontractor/Seller’s primary Employer’s Liability, Commercial General Liability, and Commercial Automobile Liability with Limits available to the Project in the amount of $1,000,000, each occurrence and aggregate, or subcontractor’s full policy limits, whichever is greater. All coverage and terms required under the Commercial General Liability, Automobile Liability and Employer’s Liability (sections 1.2, 1.2, and 1.3 above) must be included on the Umbrella Liability policy. Subcontractor’s Umbrella Liability Policy shall evidence, through a policy endorsement, that it will provide liability coverage in excess of all available underlying coverage before any primary or excess coverage held by an Additional Insured or Indemnified Party is utilized.

1.5 **Leased Employee Liability:** If Subcontractor leases one or more employees through the use of a payroll, employee management or other company, Subcontractor must directly procure workers compensation insurance. The insurance shall be written on a “Minimum Premium” or “If Any” policy form and will be in addition to the workers compensation coverage provided to and for the leased employees by the payroll, employee management or other company. In addition, the workers compensation/employer’s liability coverage provided to and for the leased employees by the payroll, employee management or other company must be evidenced and include an Alternate Employer/Leased Employee Endorsement, naming Subcontractor as the alternate employer. The employer’s liability must be scheduled under a $2,000,000 umbrella (except in states where employer’s liability is unlimited).

1.6 **Property Insurance:** Property Insurance coverage for tools and equipment owned, leased or used by the Subcontractor in the performance of the Subcontract Work of work. The Property Insurance shall extend to equipment, materials and supplies stored off the Project site or in transit to the Project site to be furnished as part of the Subcontract Work and incorporated into the Project. If Builder’s Risk or other property insurance is provided by Contractor or others, Contractor and Subcontractor waive all rights against each other and Owner, and agents or employees of any of them, separate contractors, and all other subcontractors for loss or damage to the extent covered by Builder's Risk or any other property or equipment insurance, except such rights as they may have to the proceeds of such insurance. Subcontractor shall be responsible for that portion of the Builder’s Risk deductible which is proportionate to the loss or damage resulting from acts or omissions attributable to the Subcontractor.
1.7 Professional Liability Insurance: If required, Subcontractor must comply with the requirements of the attached Appendix 2A, Professional Liability Insurance.

1.8 Riggers Liability Required: If marked as required, the Subcontract Work involves the rigging, hoisting, lowering, raising or moving of property or equipment and Riggers Liability Insurance is required to insure against physical loss or damage to the property or equipment.

1.9 Aircraft/Watercraft: If marked as required, the Subcontract Work involves the use of any owned, leased charted or hired aircraft or watercraft of any type and Aircraft Liability Insurance or Watercraft Liability Insurance, as applicable, is required in an amount of not less than $10,000,000 per occurrence, including Passenger Liability for bodily injury and property damage.

2. General Provisions: Each insurer providing insurance coverage as required in this Appendix 2 shall be a licensed admitted insurer authorized to issue such coverage in each State in which any part of the Subcontract Work is performed. The insurer shall be acceptable to Contractor and shall have an AM Best rating of “A-VI” or better. The General Liability, Umbrella Liability coverage, and Completed Operations Coverage for Additional Insured’s as required in this Appendix 2 shall be maintained from the commencement of the performance of the Subcontract Work until the end of the period of time Subcontractor may be held legally liable for its work and Subcontractor shall maintain and deliver a current Certificate of Insurance to Contractor for this period. Contractor’s right to review and approve all insurance policies will not constitute a waiver of any rights created by or provisions contained in this Appendix 2 should they differ from those contained in such policies. The insurance coverages maintained by Subcontractor shall not limit any of Subcontractor’s indemnity obligations or other liabilities under the Subcontract.

3. Additional Insureds: Unless otherwise required by the Subcontract, all insurance required by this Appendix 2 (excluding only Workers Compensation Insurance and Professional Liability Insurance) shall name Contractor, its affiliates, directors, officers, employees, and any other parties as required by the Main Contract, and shall be primary and non-contributory to any insurance maintained by Contractor and Owner and any other parties as required by Owner Contract, all of which shall be stated on the Certificate of Insurance provided by the Subcontractor. In the event Subcontractor and Contractor are covered by Contractor’s insurance, Contractor’s policy shall only apply excess of Subcontractor’s policy. The Additional Insured Endorsement must be on Form CG 2010 11/85, or CG 20 10 10/01 plus CG 20 37 10/01, or equivalent, shall include ongoing and completed operations, shall not contain any restrictions and shall be attached to the Certificate of Insurance and shall remain in full force and effect until the expiration of the statute of repose of the State in which the Project is located. Coverage shall be afforded to Additional Insureds whether or not a claim is in litigation. All insurance required by this Appendix 2 (excluding only Workers Compensation Insurance and Professional Liability Insurance) shall be endorsed to provide that, inasmuch as the policy is written to cover more than one insured, all terms, conditions, insuring agreements and endorsements, with the exception of limits of liability, shall operate in the same manner as if there were a separate policy covering each insured.

4. Prohibited Endorsements/Exclusions: Subcontractor’s Insurance shall strictly comply with the requirements of this Appendix 2 and any endorsement or exclusion which modifies the requirements herein shall not be acceptable. Without limitation to the foregoing, the following endorsements/exclusions are prohibited: 1.) Any Form, including Form CG 2924 (10-01) or its equivalent, which purports to remove the Subcontractor exception to the Damage to Your Work Exclusion is not acceptable; 2) Commercial General Liability Insurance shall not contain an endorsement or exclusion excluding injury or damage (a) arising from explosion, collapse, underground property damage or work performed by subcontractors; or (b) arising from a prior occurrence causing continuous or progressively deteriorating injury or damage; 3) There shall be no endorsement or modification of the Commercial General Liability form arising from explosion, collapse, underground property damage or work performed by subcontractors; 4) For work which involves assisted living or residential construction, Commercial General Liability Insurance shall not contain an endorsement or exclusion excluding assisted living/residential construction; 5) For work which involves an exterior insulation and finish system, Commercial General Liability Insurance shall not contain an endorsement or exclusion excluding damage or injury caused directly, indirectly, in whole or in part by the exterior insulation and finish system or by the design, installation, construction or manufacture thereof.

5. Notices: Subcontractor shall provide Jackson Contractor Group, Inc. written notice of cancellation of any insurance policy required in Appendix 1 by facsimile and U.S. Mail within two (2) days of receipt from the insurance carrier. Notice from

1st Tier 2014

JCG PM Initial: ____________________________

Subcontractor Initial: ____________________________
the Subcontractor shall be mailed to: P.O. Box 967, Missoula, MT 59806. For those policies containing an aggregate, as soon as incurred loss activity (paid plus reserve) depletes the aggregate by 50% or more, written notice must be sent to the Contractor by certified mail return receipt requested.

6. **Deductibles/Denial of Claims**: Subcontractor shall be responsible, at no additional cost to Contractor, for the payment of any deductibles or self-insured retention in connection with the insurance coverages required by this Appendix 2 both for itself and all additional insureds. Any self-insured retention or deductible in excess of $25,000 must be declared at the time Subcontractor submits its bid and must be specifically approved by Contractor prior to execution of the Subcontract. Subcontractor shall be responsible for any loss arising out of coverage denial by its insurance carrier.

7. **Waiver of Subrogation**: All insurance coverage maintained by Subcontractor shall include a waiver of any right of subrogation of the insurers thereunder against Owner, Contractor and Owner’s and Contractor’s other contractors and all of their respective assigns, subsidiaries, affiliates, employees, insurers and underwriters, and of any right of the insurers to any set-off or counterclaim or any other deduction, whether by attachment or otherwise in respect of any liability of any person insured under any such policy (Workers Compensation – where permitted). Subcontractor further waives all claims and all rights of subrogation against Owner, Contractor and Owner’s and Contractor’s other contractors and all of their respective assigns, subsidiaries, affiliates, employees, insurers and underwriters for loss of or damage to, Subcontractor’s Subcontract Work of work, tools, machinery, equipment, material, supplies or any other losses within the Subcontract Work of any insurance maintained by Subcontractor.

8. **Severability of Interests (Cross Liability)**: All Insurance required by this Appendix 2 (excluding only Workers Compensation) shall be endorsed to provide that, inasmuch as the policy is written to cover more than one insured, all terms, conditions, insuring agreements and endorsements, with the exception of limits of liability, shall operate in the same manner as if there were a separate policy covering each insured. No cross liability exclusion will be accepted. Nor shall there be any restriction in any policies that limit coverage for a claim brought by an Additional Insured against a Named insured.

9. **Breach of Insurance Requirements**: Subcontractor’s failure to obtain and maintain insurance coverage as required by this Appendix 2 shall constitute a material breach of the Subcontract. In such event Contractor may at its option: (i) terminate the Subcontractor for default; or (ii) purchase coverage and backcharge the premium and associated costs to Subcontractor.
APPENDIX 3

<table>
<thead>
<tr>
<th>Project Number:</th>
<th>Project Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subcontractor:</th>
<th></th>
</tr>
</thead>
</table>

Indemnification

This Appendix 3 is hereby made a part of the Subcontract by and between Contractor and Subcontractor.

1. Subcontractor assumes responsibility for and agrees at the sole discretion of Contractor to defend, indemnify and hold Contractor, Contractor’s surety and Owner (hereinafter “Indemnities”) harmless from any and all claims, demands, damages, expenses, losses, fines, penalties or liabilities, including loss of use, arising from, resulting in any manner directly or indirectly from or connected with or in the course of the performance of the Subcontract Work or the Subcontract obligations, including without limitation claims of subcontractors and suppliers contracting with Subcontractor. Subcontractor's obligation to defend, indemnify and hold Indemnities harmless shall include, but will not be limited to, the reasonable hourly rate and expenses of Indemnities' employees and officers spent in connection with the claim, demand fare, penalty or liability, attorney and expert fees, court costs, and all other claim-related expenses, to the fullest extent permitted by law, even though such claims may prove to be false, groundless, or fraudulent, subject only to the limitations provided below.

   (a) Subcontractor's duty to defend and indemnify shall not apply to liability for damages caused by or resulting from the sole negligence of Indemnities, or their agents or employees.

   (b) If under the laws determined to be applicable to this paragraph, defense and indemnification of concurrent negligence is valid only to the extent of the negligence of Subcontractor, its agents or employees, then Subcontractor's duty to defend and indemnify for liability for damages caused by or resulting from the concurrent negligence of (i) Indemnities, or their agents or employees, and (ii) Subcontractor or Subcontractor's agents or employees, shall apply only to the extent of negligence of Subcontractor or Subcontractor's agents or employees. This exception shall not apply when negligence is not a requirement of liability.

2. For the purposes of these indemnification provisions only, Subcontractor specifically and expressly waives any immunity that may be granted it under the worker’s compensation laws of any state, including but not limited to, Washington State Industrial Insurance Act, Title 51 RCW; Idaho Worker’s Compensation Act, Sec. 72-209; Alaska Worker’s Compensation Act, Sec. 23.30.055; Montana Worker’s Compensation Act, Sec. 39-71-411; California Labor Code, Sec. 3864; and Oregon Worker’s Compensation Act, Sec. 656.018; provided that such waiver shall be expressly limited to Subcontractor's indemnity obligations herein and shall not be intended as a benefit to any third party. Further, the indemnification obligation under this Subcontract shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable to or for any third party under worker's compensation acts, disability benefits acts, or other employee benefits acts.

3. Subcontractor's indemnification obligations as stated herein shall extend to claims occurring after this subcontract agreement is terminated as well as while it is in force. Nothing in this Appendix 3 shall grant any third-party beneficiary rights to the Owner.

4. The partial or complete invalidity of any one or more provisions of this Appendix shall not affect the validity or continuing force and effect of any other provision. If any provision is invalid, in whole or in part, the balance of the provisions shall be considered reformed to reflect the intent of the parties to the greatest extent possible consistent with the law.

THE UNDERSIGNED HEREBY CERTIFY THAT THIS APPENDIX WAS MUTUALLY NEGOTIATED.

Jackson Contractor Group, Inc.: [Subcontractor]:
By: ___________________________ By: ___________________________
Name & Title: ______________________________ Name & Title: ___________________________
Date: ___________________________ Date: ___________________________

JCG PM Initial: ___________________________
Subcontractor Initial: ___________________
APPENDIX 5
Special Provisions

This Appendix 5 is hereby made a part of the Subcontract by and between Contractor and Subcontractor.

1. Prior to mobilization on site, subcontractor must submit to Jackson Contractor Group, Inc. a written Safety Plan or a copy of the company’s safety program. The subcontractor must submit the name of the individual who is responsible for the implementation of the safety plan or program. This individual must have authority to direct job site foremen and superintendents to comply with company directives. No payments for any work performed on the project will be made until satisfactory completion of the foregoing requirements.

2. Subcontractor agrees that if in the performance of this subcontract it becomes necessary, convenient or advisable to remove, replace or interfere with any safety devices or controls installed by the contractor or another subcontractor, this subcontractor will replace or restore such devices or controls at his expense. In the event such safety devices or controls are not so replaced or restored, subcontractor agrees to reimburse the contractor for doing so for subcontractor’s account.

3. The subcontractor shall be responsible for material handling and hoisting its materials, supplies and equipment and for its own scaffolding.

4. Water will be available from a single source near the building pad provided by plumber.

5. Each subcontractor is responsible for acceptance of the site prior to commencement of the project. The specifications require all unimproved portions of the site be returned to the condition the site was in prior to the start of any work. All debris, whether on the surface or below the surface, must be removed.

6. This subcontractor shall comply with OSHA law that requires any and all suppliers or manufacturers to supply a Material Safety Data Sheet (MSDS) for products used on the above-mentioned job. Jackson Contractor Group, Inc. will be making periodic requests for this information as required. This subcontractor agrees to comply with these requirements in a timely manner.

7. Pursuant to Provisions of the subcontract, an essential subcontract requirement shall be completion of work activities within the time durations provided in the project schedule. This subcontractor must review the work to familiarize itself with the time required for construction and recognize the possibility of multiple move-ins, overtime, and shift work to complete its scope of work as required by the project schedule. If subcontractor fails to meet scheduled completion dates for individual activities, Jackson Contractor Group, Inc. shall have the right to require additional manpower and/or multiple shift work of the subcontractor at no cost to Jackson Contractor Group until the delayed activity has been corrected. Subcontractor will also be responsible for the cost of accelerating subsequent trades if required by subcontractor’s failure to meet schedule requirements.

8. Coordination with other trades will be the responsibility of the subcontractor. Subcontractor shall provide coordination drawings as required. Interference due to lack of complete coordination will be the responsibility of each subcontractor. Potential conflicts, delays, and quality concerns must be aggressively pursued by the subcontractor with the other trades before they affect the construction progress.

9. This subcontractor shall provide fire extinguishers, flash screens, and watchmen at the location of welding and torch cutting. The subcontractor is responsible for procuring any required cutting and burning permits if required. Protection of all work is included.

10. Individual task lighting for remote location or individual rooms will be the responsibility of each subcontractor for the satisfactory performance of its work.

11. Subcontractor is responsible for its’ own cutting, patching, and coring.

12. Subcontractor shall provide fire safinig, fire/security sealants, escutcheons, and sleeves, for all penetrations through walls, slabs, floors, and roofs where required by the documents.

13. Subcontractor shall be responsible for all notes and details pertaining to its scope of work, regardless of what area of the plans or specifications the notes and/or details are found.

14. Contractor will not provide telephone service, temporary fences, barricades, field office, field office electricity or laydown areas, or subcontractors/vendors. Temporary toilets will be provided. Construction water will be made available at a source close to the work area. All distribution is by the Subcontractor. The Subcontractor is responsible for all drinking water and ice required for its work force.

15. Jackson Contractor Group will provide contractor with one electronic set of contract documents all additional sets must be purchased by the subcontractor.

16. Each subcontractor is required to maintain monthly as-built drawing updates. This is a requirement before receiving monthly progress payments. The master set will be located in Jackson Contractor Groups site offices. All underground conduit and piping must be identified and dimensioned off grid line.

17. The project superintendent will schedule weekly coordination meeting with all subcontractors and major material suppliers to review job progress, resolve problems and disseminate information concerning schedules, changes or any other matters of general information. Attendance at these meetings is mandatory. Failure of subcontractor to attend regular scheduled meetings will not relieve the subcontractor of its responsibility to perform work or otherwise comply with instructions given out during the meeting.

18. Weekly Tool Box Safety Meetings will be held by all subcontractors. Subcontractor will furnish meeting notes to Jackson Contractor Group, Inc. on a weekly basis. Special safety meetings will be scheduled by Jackson Contractor Group, Inc. from time to time as job conditions warrant. Subcontractors notifies of these safety meetings will be expected to have their representatives in attendance.

19. Subcontractor shall provide temporary protection for all work adjacent to or susceptible to damage by its own work, including, but not limited, to protection of floors, walls, ceilings, roofs, fixtures, and mechanization equipment. Costs to repair damaged work will be the responsibility of each subcontractor. The decision of the Jackson Contractor Group Superintendent shall be final in determining who damaged, or likely damaged the work.
20. Each subcontractor shall organize all loose materials to the greatest extent possible and shall coordinate storage with the project superintendent.

21. The subcontractor will make arrangements to remove from the work area all debris cartons, crates, and boxes at the end of each day. This debris will be deposited in dumpsters furnished by Jackson Contractor Group. Work areas are to be maintained in a broom clean condition. Inform your superintendent or foreman of this requirement. Should you fail or refuse to perform the cleanup, the Jackson Contractor Group, Inc. superintendent shall cause this work to be performed by others and the entire cost thereof, plus handling charges for removal to the dump, will be assessed against the party responsible. One day’s verbal notice to the subcontractor’s field foreman or leadman is all that will be given. The decision of the Jackson Contractor Group, Inc. superintendent shall be final in determining when the safety and good order of the project require the clean up to be performed.

22. Subcontractor will provide dust control for its own work.

23. This subcontract includes spare parts, training, O & M manuals and all other close out requirements as specified. No payments beyond 90% of the contract value will be made prior to submission of required O & M manuals.

24. Provide any embeds or sleeves required for casting into walls, footings, or slabs. Subcontractor shall be responsible for the timely furnishings, layout and installation of all nailers, insets, blockouts, penetrations, sleeves, etc., as may be specified and/or required for their scope of work.

25. Access doors are to be provided as required for your work. All access panel locations must be provided to the Contractor framing the opening prior to constructing the element to receive the access door. Failure to locate panels will result in your account being charged the cost of reframing and repairing finishes if necessary.

26. All materials delivered to the site will be scheduled with Jackson Contractor Group 48 hours prior to delivery. All necessary security forms and procedures as outlined in the division 1 specifications shall be strictly followed in their entirety. All traffic control (i.e. flagmen, etc.) will be provided by this Subcontractor for his deliveries. There will be no onsite storage of materials unless specifically approved by the superintendent. All unscheduled deliveries will be turned away. The Subcontractor assumes all protection and liability for material stored onsite. Refer to project specifications for specific routing of all deliveries.

27. All change orders must be processed in a timely manner and must be submitted in full analytical detail as required by the Owner.

28. High visibility safety vests or t-shirts must be worn by each employee on the job site at all times. Acceptable colors will be orange, green or red.

29. Safety violations will be enforced financial as follows. 1st time offence will be a written warning sent to your office, 2nd offence will be a written violation and a $50.00 penalty deducted from your monthly pay request/retention, 3rd offence same as second but $100.00, and so on. These violations are not per employee and are per company. Repeat offenders will be removed at the discretion of Jackson Contractor Group, Inc.
APPENDIX 6
Subcontractor & Major Supplier Affidavit

Project Number: ___________________________
Project Name: _____________________________
Cost Code: _________________________________
Subcontractor: _____________________________

This affidavit is to be completed by each subcontractor or supplier (including lower tier subcontractors) and submitted to Jackson Contractor Group. The Subcontractor shall submit the completed affidavits to Jackson Contractor Group no later than 5:00 p.m. on the fifth business day following the award of contract. The Subcontractor may attach additional sheets if more space is required to provide complete information.

You are required to complete and return this form per your contract terms prior to commencement of any work, for approval of all subcontractors to be used on the above referenced project. If no work is to be subcontracted, please write “Not Applicable”.

1. Please list major vendors/suppliers of goods/services/supplies for this project:

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone</th>
<th>Product(s)</th>
<th>Amount ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Please describe scope of work:

3. Check one:

☐ We will NOT subcontract out ANY portion of our work to another subcontractor:

☐ We WILL subcontract out ___% of our work to:

<table>
<thead>
<tr>
<th>Firm, Contact Person, Phone Number</th>
<th>Amount ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

☐ We WILL subcontract out ___% of our work to:

<table>
<thead>
<tr>
<th>Firm, Contact Person, Phone Number</th>
<th>Amount ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

☐ We WILL subcontract out ___% of our work to:

<table>
<thead>
<tr>
<th>Firm, Contact Person, Phone Number</th>
<th>Amount ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please submit progress and final lien waivers for the above-listed subcontractors and suppliers together with your lien releases and monthly acknowledgements. Please only submit said waivers grouped together and not independently throughout the month.

I declare, under penalty of perjury, that the above information is true and correct and that if our firm engages into contract or purchase order with any other firm not listed above, that this additional information will be given to Jackson Contractor Group immediately upon execution of contract or purchase order.

____________________________________________________________________
Signature Date

Name and Title (Print) Phone

1st Tier 2014

JCG PM Initial: Subcontractor Initial: __________________________
Museum of the Rockies Collections & Storage Facility
Bozeman, MT

8. SAMPLE ENVELOPE AND LABEL
Bid Envelope Sample:
- Must be sealed in an opaque envelope.
- Must have the bidders Name, Address and Montana State Contractor’s License #.
- Must be addressed to Montana State University (as indicated below).
- Must be clearly labels as a Bid Proposal for “Museum of the Rockies Collections & Storage Facility Bid Schedule #1.”
- Must clearly state what Bid Item you are bidding.
- Use multiple envelopes if you are bidding more than one Bid Item – DO NOT combine multiple Bid Items.

---

Jackson Contractor Group, Inc.
C/O Montana State University
Facilities, Planning, Design, & Construction
Plew Building
6th & Grant
Bozeman, MT 59717
MONTANA
PREVAILING WAGE RATES FOR BUILDING CONSTRUCTION SERVICES 2016

Effective: January 2, 2016

Steve Bullock, Governor
State of Montana

Pam Bucy, Commissioner
Department of Labor and Industry

To obtain copies of prevailing wage rate schedules, or for information relating to public works projects and payment of prevailing wage rates, visit ERD at www.mtwagehourbopa.com or contact:

Employment Relations Division
Montana Department of Labor and Industry
P. O. Box 201503
Helena, MT 59620-1503
Phone 406-444-5600
TDD 406-444-5549

The Labor Standards Bureau welcomes questions, comments and suggestions from the public. In addition, we’ll do our best to provide information in an accessible format, upon request, in compliance with the Americans with Disabilities Act.

MONTANA PREVAILING WAGE REQUIREMENTS

The Commissioner of the Department of Labor and Industry, in accordance with Sections 18-2-401 and 18-2-402 of the Montana Code Annotated (MCA), has determined the standard prevailing rate of wages for the occupations listed in this publication.

The wages specified herein control the prevailing rate of wages for the purposes of Section 18-2-401, et seq., MCA. It is required that each employer pay (as a minimum) the rate of wages, including fringe benefits, travel allowance, zone pay and per diem applicable to the district in which the work is being performed as provided in the attached wage determinations.

All Montana Prevailing Wage Rates are available on the internet at www.mtwagehourbopa.com or by contacting the Labor Standards Bureau at (406) 444-5600 or TDD (406) 444-5549.

In addition, this publication provides general information concerning compliance with Montana’s Prevailing Wage Law and the payment of prevailing wages. For detailed compliance information relating to public works contracts and payment of prevailing wage rates, please consult the regulations on the internet at www.mtwagehourbopa.com or contact the Labor Standards Bureau at (406) 444-5600 or TDD (406) 444-5549.

PAM BUCY
Commissioner
Department of Labor and Industry
State of Montana
TABLE OF CONTENTS

MONTANA PREVAILING WAGE REQUIREMENTS:

A. Date of Publication .......................................................... 3
B. Definition of Building Construction ..................................... 3
C. Definition of Public Works Contract .................................... 3
D. Prevailing Wage Schedule .................................................. 3
E. Rates to Use for Projects .................................................... 3
F. Wage Rate Adjustments for Multiyear Contracts .................... 3
G. Fringe Benefits .............................................................. 4
H. Prevailing Wage Districts ................................................... 4
I. Dispatch City .................................................................. 5
J. Zone Pay ....................................................................... 5
K. Computing Travel Benefits ............................................... 5
L. Per Diem ..................................................................... 5
M. Apprentices .................................................................. 5
N. Posting Notice of Prevailing Wages ................................... 5
O. Employment Preference .................................................... 5
P. Building Construction Occupations Website ....................... 5
Q. Welder Rates .................................................................. 5
R. Foreman Rates ............................................................... 5

WAGE RATES:

BOILERMAKERS .................................................................. 6
BRICK, BLOCK, AND STONE MASONS .................................... 6
CARPENTERS .................................................................... 6
CEMENT MASONS AND CONCRETE FINISHERS ...................... 6
CONSTRUCTION EQUIPMENT OPERATORS .............................
   OPERATORS GROUP 1 ...................................................... 7
   OPERATORS GROUP 2 ...................................................... 7
   OPERATORS GROUP 3 ...................................................... 8
   OPERATORS GROUP 4 ...................................................... 8
   OPERATORS GROUP 5 ...................................................... 8
   OPERATORS GROUP 6 ...................................................... 9
   OPERATORS GROUP 7 ...................................................... 9
CONSTRUCTION LABORERS ................................................
   LABORERS GROUP 1 ...................................................... 9
   LABORERS GROUP 2 ...................................................... 10
   LABORERS GROUP 3 ...................................................... 10
   LABORERS GROUP 4 ...................................................... 11
DRYWALL APPLICATORS .......................................................
   ELECTRICIANS: INCLUDING BUILDING AUTOMATION CONTROL
   ELEVATOR CONSTRUCTORS ............................................... 12
   FLOOR LAYERS ............................................................. 12
GLAZIERS ....................................................................... 13
HEATING AND AIR CONDITIONING ......................................... 13
INSULATION WORKERS - MECHANICAL (HEAT AND FROST) .... 14
IRONWORKERS - STRUCTURAL STEEL AND REBAR PLACERS . 14
MILLWRIGHTS .................................................................. 14
PAINTERS: INCLUDING PAPERHANGERS .................................. 14
PILE BUCKS .................................................................... 15
PLASTERERS ................................................................... 15
PLUMBERS, PIPEFITTERS, AND STEAMFITTERS ..................... 15
ROOFERS ....................................................................... 16
SHEET METAL WORKERS ...................................................... 16
SPRINKLER FITTERS ........................................................... 16
TAPERS .......................................................................... 17
TEAMSTERS GROUP 2 (TRUCK DRIVERS) ................................. 17
TELECOMMUNICATIONS EQUIPMENT INSTALLERS ................. 17
TILE AND MARBLE SETTERS ............................................... 17
A. Date of Publication January 2, 2016

B. Definition of Building Construction
For the purposes of Prevailing Wage, the Commissioner of Labor and Industry has determined that building construction occupations are defined to be those performed by a person engaged in a recognized trade or craft, or any skilled, semi-skilled, or unskilled manual labor related to the construction, alteration, or repair of a public building or facility, and does not include engineering, superintendence, management, office or clerical work.

The Administrative Rules of Montana (ARM), 24.17.501(2) – 2(a), states “Building construction projects generally are the constructions of sheltered enclosures with walk-in access for housing persons, machinery, equipment, or supplies. It includes all construction of such structures, incidental installation of utilities and equipment, both above and below grade level, as well as incidental grading, utilities and paving.

Examples of building construction include, but are not limited to, alterations and additions to buildings, apartment buildings (5 stories and above), arenas (closed), auditoriums, automobile parking garages, banks and financial buildings, barracks, churches, city halls, civic centers, commercial buildings, court houses, detention facilities, dormitories, farm buildings, fire stations, hospitals, hotels, industrial buildings, institutional buildings, libraries, mausoleums, motels, museums, nursing and convalescent facilities, office buildings, out-patient clinics, passenger and freight terminal buildings, police stations, post offices, power plants, prefabricated buildings, remodeling buildings, renovating buildings, repairing buildings, restaurants, schools, service stations, shopping centers, stores, subway stations, theaters, warehouses, water and sewage treatment plants (buildings only), etc.”

C. Definition of Public Works Contract
Section 18-2-401(11)(a), MCA defines “public works contract” as “…a contract for construction services let by the state, county, municipality, school district, or political subdivision or for nonconstruction services let by the state, county, municipality, or political subdivision in which the total cost of the contract is in excess of $25,000...

D. Prevailing Wage Schedule
This publication covers only Building Construction occupations and rates. These rates will remain in effect until superseded by a more current publication. Current prevailing wage rate schedules for Heavy Construction, Highway Construction, and Nonconstruction Services occupations can be found on the internet at www.mtwagehourbopa.com or by contacting the Labor Standards Bureau at (406) 444-5600 or TDD (406) 444-5549.

E. Rates to Use for Projects
ARM, 24.17.127(1)(c), states “The wage rates applicable to a particular public works project are those in effect at the time the bid specifications are advertised.”

F. Wage Rate Adjustments for Multiyear Contracts
Section 18-2-417, MCA states:

“(1) Any public works contract that by the terms of the original contract calls for more than 30 months to fully perform must include a provision to adjust, as provided in subsection (2), the standard prevailing rate of wages to be paid to the workers performing the contract.

(2) The standard prevailing rate of wages paid to workers under a contract subject to this section must be adjusted 12 months after the date of the award of the public works contract. The amount of the adjustment must be a 3% increase. The adjustment must be made and applied every 12 months for the term of the contract.

(3) Any increase in the standard rate of prevailing wages for workers under this section is the sole responsibility of the contractor and any subcontractors and not the contracting agency.”
G. Fringe Benefits
Section 18-2-412, MCA states:

“(1) To fulfill the obligation...a contractor or subcontractor may:

(a) pay the amount of fringe benefits and the basic hourly rate of pay that is part of the standard prevailing rate of wages directly to the worker or employee in cash;

(b) make an irrevocable contribution to a trustee or a third person pursuant to a fringe benefit fund, plan, or program that meets the requirements of the Employee Retirement Income Security Act of 1974 or that is a bona fide program approved by the U. S. department of labor; or

(c) make payments using any combination of methods set forth in subsections (1)(a) and (1)(b) so that the aggregate of payments and contributions is not less than the standard prevailing rate of wages, including fringe benefits and travel allowances, applicable to the district for the particular type of work being performed.

(2) The fringe benefit fund, plan, or program described in subsection (1)(b) must provide benefits to workers or employees for health care, pensions on retirement or death, life insurance, disability and sickness insurance, or bona fide programs that meet the requirements of the Employee Retirement Income Security Act of 1974 or that are approved by the U. S. department of labor.”

Fringe benefits are paid for all hours worked (straight time and overtime hours). However, fringe benefits are not to be considered a part of the hourly rate of pay for calculating overtime, unless there is a collectively bargained agreement in effect that specifies otherwise.

H. Prevailing Wage Districts
Montana counties are aggregated into 4 districts for the purpose of prevailing wage. The prevailing wage districts are composed of the following counties:

Montana Prevailing Wage Districts
I. Dispatch City
ARM, 24.17.103(11), defines dispatch city as “…the courthouse in the city from the following list which is closest to the center of the job: Billings, Bozeman, Butte, Great Falls, Helena, Kalispell, and Missoula.” A dispatch city shall be considered the point of origin only for jobs within the counties identified in that district (as shown below):

- **District 1 – Kalispell and Missoula:** includes Flathead, Lake, Lincoln, Mineral, Missoula, Ravalli, and Sanders;
- **District 2 – Butte and Helena:** includes Beaverhead, Broadwater, Deer Lodge, Glacier, Granite, Jefferson, Lewis and Clark, Liberty, Madison, Pondera, Powell, Silver Bow, Teton, and Toole;
- **District 3 – Bozeman and Great Falls:** includes Blaine, Cascade, Chouteau, Fergus, Gallatin, Golden Valley, Hill, Judith Basin, Meagher, Park, Petroleum, Phillips, Sweet Grass, and Wheatland;
- **District 4 – Billings:** includes Big Horn, Carbon, Carter, Custer, Daniels, Dawson, Fallon, Garfield, McCona, Musselshell, Powder River, Prairie, Richland, Roosevelt, Rosebud, Sheridan, Stillwater, Treasure, Valley, Wibaux, and Yellowstone.

J. Zone Pay
Zone pay is not travel pay. ARM, 24.17.103(24), defines zone pay as “…an amount added to the base pay; the combined sum then becomes the new base wage rate to be paid for all hours worked on the project. Zone pay must be determined by measuring the road miles one way over the shortest practical maintained route from the dispatch city to the center of the job.” See section I above for a list of dispatch cities.

K. Computing Travel Benefits
ARM, 24.17.103(22), states “‘Travel pay,’ also referred to as ‘travel allowance,’ is and must be paid for travel both to and from the job site, except those with special provisions listed under the classification. The rate is determined by measuring the road miles one direction over the shortest practical maintained route from the dispatch city or the employee’s home, whichever is closer, to the center of the job.” See section I above for a list of dispatch cities.

L. Per Diem
ARM, 24.17.103(18), states “’Per diem’ typically covers costs associated with board and lodging expenses. Per diem is paid when an employee is required to work at a location outside the daily commuting distance and is required to stay at that location overnight or longer.”

M. Apprentices
Wage rates for apprentices registered in approved federal or state apprenticeship programs are contained in those programs. Additionally, Section 18-2-416(2), MCA states “…The full amount of any applicable fringe benefits must be paid to the apprentice while the apprentice is working on the public works contract.” Apprentices not registered in approved federal or state apprenticeship programs will be paid the appropriate journey level prevailing wage rate when working on a public works contract.

N. Posting Notice of Prevailing Wages
Section 18-2-406, MCA provides that contractors, subcontractors and employers who are “…performing work or providing construction services under public works contracts, as provided in this part, shall post in a prominent and accessible site on the project or staging area, not later than the first day of work and continuing for the entire duration of the project, a legible statement of all wages and fringe benefits to be paid to the employees.”

O. Employment Preference
Sections 18-2-403 and 18-2-409, MCA requires contractors to give preference to the employment of bona fide Montana residents in the performance of work on public works contracts.

P. Building Construction Occupations Website
You can find definitions for these occupations on the following Bureau of Labor Statistics website: http://www.bls.gov/oes/current/oes_stru.htm

Q. Welder Rates
Welders receive the rate prescribed for the craft performing an operation to which welding is incidental.

R. Foreman Rates
Rates are no longer set for foremen. However, if a foreman performs journey level work, the foreman must be paid at least the journey level rate.
## WAGE RATES

### BOILERMAKERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$30.00</td>
<td>$30.30</td>
</tr>
<tr>
<td>District 2</td>
<td>$30.00</td>
<td>$30.30</td>
</tr>
<tr>
<td>District 3</td>
<td>$30.00</td>
<td>$30.30</td>
</tr>
<tr>
<td>District 4</td>
<td>$30.00</td>
<td>$30.30</td>
</tr>
</tbody>
</table>

**Duties Include:**
Construct, assemble, maintain, and repair stationary steam boilers and boiler house auxiliaries.

**Travel:**
- **All Districts**
  - 0-120 mi. free zone
  - >120 mi. federal mileage rate/mi. in effect when travel occurs.

**Special Provision:**
Travel is paid only at the beginning and end of the job.

**Per Diem:**
- **All Districts**
  - 0-70 mi. free zone
  - >70-120 mi. $55.00/day
  - >120 mi. $70.00/day

### BRICK, BLOCK, AND STONE MASONS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$26.41</td>
<td>$13.19</td>
</tr>
<tr>
<td>District 2</td>
<td>$26.41</td>
<td>$13.19</td>
</tr>
<tr>
<td>District 3</td>
<td>$26.05</td>
<td>$13.19</td>
</tr>
<tr>
<td>District 4</td>
<td>$26.05</td>
<td>$13.19</td>
</tr>
</tbody>
</table>

**Travel:**
- **All Districts**
  - 0-45 mi. free zone
  - >45-60 mi. $25.00/day
  - >60-90 mi. $55.00/day
  - >90 mi. $65.00/day

### CARPENTERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$22.00</td>
<td>$11.57</td>
</tr>
<tr>
<td>District 2</td>
<td>$22.00</td>
<td>$11.86</td>
</tr>
<tr>
<td>District 3</td>
<td>$22.00</td>
<td>$11.57</td>
</tr>
<tr>
<td>District 4</td>
<td>$24.59</td>
<td>$11.57</td>
</tr>
</tbody>
</table>

**Zone Pay:**
- **All Districts**
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $4.00/hr.
  - >60 mi. base pay + $6.00/hr.

**Duties Include:**
Install roll and batt insulation, and hardwood floors.

### CEMENT MASONS AND CONCRETE FINISHERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$21.20</td>
<td>$10.68</td>
</tr>
<tr>
<td>District 2</td>
<td>$21.43</td>
<td>$9.41</td>
</tr>
<tr>
<td>District 3</td>
<td>$23.63</td>
<td>$7.19</td>
</tr>
<tr>
<td>District 4</td>
<td>$21.44</td>
<td>$7.14</td>
</tr>
</tbody>
</table>

**Zone Pay:**
- **All Districts**
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $2.95/hr.
  - >60 mi. base pay + $4.75/hr.

**Duties Include:**
Smooth and finish surfaces of poured concrete, such as floors, walks, sidewalks, or curbs. Align forms for sidewalks, curbs, or gutters.
CONSTRUCTION EQUIPMENT OPERATORS GROUP 1

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$23.47</td>
<td>$11.05</td>
</tr>
<tr>
<td>2</td>
<td>$23.47</td>
<td>$11.05</td>
</tr>
<tr>
<td>3</td>
<td>$23.47</td>
<td>$11.05</td>
</tr>
<tr>
<td>4</td>
<td>$23.47</td>
<td>$11.05</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
- Air Compressor; Auto Fine Grader; Belt Finishing; Boring Machine (Small); Cement Silo; Crane, A-Frame Truck Crane; Crusher Conveyor; DW-10, 15, and 20 Tractor Roller; Farm Tractor; Forklift; Form Grader; Front-End Loader, under 1 cu. yd; Oiler, Heavy Duty Drills; Herman Nelson Heater; Mucking Machine; Oiler, All Except Cranes/Shovels; Pumpman.

Zone Pay:
- All Districts
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $3.50/hr.
  - >60 mi. base pay + $5.50/hr.

CONSTRUCTION EQUIPMENT OPERATORS GROUP 2

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$23.94</td>
<td>$11.05</td>
</tr>
<tr>
<td>2</td>
<td>$23.94</td>
<td>$11.05</td>
</tr>
<tr>
<td>3</td>
<td>$23.94</td>
<td>$11.05</td>
</tr>
<tr>
<td>4</td>
<td>$23.94</td>
<td>$11.05</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
- Air Doctor; Backhoe\Excavator\Shovel, up to and incl. 3 cu. yds; Bit Grinder; Bituminous Paving Travel Plant; Boring Machine, Large; Broom, Self-Propelled; Concrete Travel Batcher; Concrete Float & Spreader; Concrete Bucket Dispatcher; Concrete Finish Machine; Concrete Conveyor; Distributor; Dozer, Rubber-Tired, Push, & Side Boom; Elevating Grader\Gradall; Field Equipment Serviceman; Front-End Loader, 1 cu. yd up to and incl. 5 cu. yds; Grade Setter; Heavy Duty Drills, All Types; Hoist\Tugger, All; Hydralift Forklifts & Similar; Industrial Locomotive; Motor Patrol (except finish); Mountain Skidder; Oiler, Cranes/Shovels; Pavement Breaker, EMSCO; Power Saw, Self-Propelled; Pugmill; Pumppcrete\Grout Machine; Punch Truck; Roller, other than Asphalt; Roller, Sheepsfoot (Self-Propelled); Roller, 25 tons and over; Ross Carrier; Rotomill, under 6 ft; Trenching Machine; Washing /Screening Plant.

Zone Pay:
- All Districts
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $3.50/hr.
  - >60 mi. base pay + $5.50/hr.
### CONSTRUCTION EQUIPMENT OPERATORS GROUP 3

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$23.35</td>
<td>$11.05</td>
</tr>
<tr>
<td>2</td>
<td>$24.34</td>
<td>$11.05</td>
</tr>
<tr>
<td>3</td>
<td>$23.78</td>
<td>$9.41</td>
</tr>
<tr>
<td>4</td>
<td>$24.34</td>
<td>$11.05</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone Pay:</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Districts</td>
</tr>
<tr>
<td>0-30 mi. free zone</td>
</tr>
<tr>
<td>&gt;30-60 mi. base pay + $3.50/hr.</td>
</tr>
<tr>
<td>&gt;60 mi. base pay + $5.50/hr.</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
- Asphalt Paving Machine
- Asphalt Screed
- Backhoe
- Excavator
- Shovel, over 3 cu. yds
- Cableway Highline
- Concrete Batch Plant
- Concrete Curing Machine
- Concrete Pump
- Cranes, Creter
- Cranes, Electric Overhead
- Cranes, 24 tons and under
- Curb Machine
- Slip Form Paver
- Finish Dozer
- Front-End Loader, over 5 cu. yds
- Mechanic
- Welder
- Pioneer Dozer
- Roller Asphalt (Breakdown & Finish)
- Rotomill, over 6 ft
- Scraper, Single, Twin, or Pulling Belly-Dump
- YO-YO Cat.

### CONSTRUCTION EQUIPMENT OPERATORS GROUP 4

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$25.00</td>
<td>$11.05</td>
</tr>
<tr>
<td>2</td>
<td>$25.00</td>
<td>$11.05</td>
</tr>
<tr>
<td>3</td>
<td>$25.00</td>
<td>$11.05</td>
</tr>
<tr>
<td>4</td>
<td>$25.00</td>
<td>$11.05</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone Pay:</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Districts</td>
</tr>
<tr>
<td>0-30 mi. free zone</td>
</tr>
<tr>
<td>&gt;30-60 mi. base pay + $3.50/hr.</td>
</tr>
<tr>
<td>&gt;60 mi. base pay + $5.50/hr.</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
- Asphalt Hot Plant Operator
- Cranes, 25 tons up to and incl. 44 tons
- Crusher Operator
- Finish Motor Patrol
- Finish Scraper

### CONSTRUCTION EQUIPMENT OPERATORS GROUP 5

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$25.50</td>
<td>$11.05</td>
</tr>
<tr>
<td>2</td>
<td>$25.50</td>
<td>$11.05</td>
</tr>
<tr>
<td>3</td>
<td>$25.50</td>
<td>$11.05</td>
</tr>
<tr>
<td>4</td>
<td>$25.50</td>
<td>$11.05</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone Pay:</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Districts</td>
</tr>
<tr>
<td>0-30 mi. free zone</td>
</tr>
<tr>
<td>&gt;30-60 mi. base pay + $3.50/hr.</td>
</tr>
<tr>
<td>&gt;60 mi. base pay + $5.50/hr.</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
- Cranes, 45 tons up to and incl. 74 tons.
### CONSTRUCTION EQUIPMENT OPERATORS GROUP 6

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
<th>Zone Pay:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$26.60</td>
<td>$11.05</td>
<td>All Districts</td>
</tr>
<tr>
<td>2</td>
<td>$26.60</td>
<td>$11.05</td>
<td>0-30 mi. free zone</td>
</tr>
<tr>
<td>3</td>
<td>$26.60</td>
<td>$11.05</td>
<td>&gt;30-60 mi. base pay + $3.50/hr.</td>
</tr>
<tr>
<td>4</td>
<td>$26.60</td>
<td>$11.05</td>
<td>&gt;60 mi. base pay + $5.50/hr.</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
Cranes, 75 tons up to and incl. 149 tons; Cranes, Whirley (All).

### CONSTRUCTION EQUIPMENT OPERATORS GROUP 7

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
<th>Zone Pay:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$27.10</td>
<td>$11.05</td>
<td>All Districts</td>
</tr>
<tr>
<td>2</td>
<td>$27.10</td>
<td>$11.05</td>
<td>0-30 mi. free zone</td>
</tr>
<tr>
<td>3</td>
<td>$27.10</td>
<td>$11.05</td>
<td>&gt;30-60 mi. base pay + $3.50/hr.</td>
</tr>
<tr>
<td>4</td>
<td>$27.10</td>
<td>$11.05</td>
<td>&gt;60 mi. base pay + $5.50/hr.</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
Cranes, 150 tons up to and incl. 250 tons; Cranes, over 250 tons—add $1.00 for every 100 tons over 250 tons; Crane, Tower (All); Crane Stiff-Leg or Derrick; Helicopter Hoist.

### CONSTRUCTION LABORERS GROUP 1 / FLAG PERSON FOR TRAFFIC CONTROL

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
<th>Zone Pay:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$17.35</td>
<td>$8.04</td>
<td>All Districts</td>
</tr>
<tr>
<td>2</td>
<td>$18.00</td>
<td>$8.70</td>
<td>0-30 mi. free zone</td>
</tr>
<tr>
<td>3</td>
<td>$18.00</td>
<td>$7.24</td>
<td>&gt;30-60 mi. base pay + $1.50/hr.</td>
</tr>
<tr>
<td>4</td>
<td>$18.00</td>
<td>$7.24</td>
<td>&gt;60 mi. base pay + $3.90/hr.</td>
</tr>
</tbody>
</table>

Districts 2, 3 & 4
0-15 mi. free zone
>15-30 mi. base pay + $0.65/hr.
>30-50 mi. base pay + $0.85/hr.
>50 mi. base pay + $1.25/hr.
CONSTRUCTION LABORERS GROUP 2

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$16.27</td>
<td>$6.18</td>
</tr>
<tr>
<td>District 2</td>
<td>$17.47</td>
<td>$7.68</td>
</tr>
<tr>
<td>District 3</td>
<td>$16.28</td>
<td>$6.25</td>
</tr>
<tr>
<td>District 4</td>
<td>$18.00</td>
<td>$6.61</td>
</tr>
</tbody>
</table>

This group includes but is not limited to: General Labor; Asbestos Removal; Burning Bar; Bucket Man; Carpenter Tender; Caisson Worker; Cement Mason Tender; Cement Handler (dry); Chuck Tender; Choker Setter; Concrete Worker; Curb Machine-lay Down; Crusher and Batch Worker; Heater Tender; Fence Erector; Landscape Laborer; Landscaper; Lawn Sprinkler Installer; Pipe Wrapper; Pot Tender; Powderman Tender; Rail and Truck Loaders and Unloaders; Riprapper; Sign Erection; Guardrail and Jersey Rail; Spike Driver; Stake Jumper; Signalman; Tail Hoseman; Tool Checker and Houseman and Traffic Control Worker.

Zone Pay:

**District 1**
- 0-30 mi. free zone
- >30-60 mi. base pay + $1.50/hr.
- >60 mi. base pay + $3.90/hr.

**District 2**
- 0-15 mi. free zone
- >15-30 mi. base pay + $1.55/hr.
- >30-50 mi. base pay + $3.10/hr.
- >50 mi. base pay + $4.65/hr.

**Districts 3 & 4**
- 0-15 mi. free zone
- >15-30 mi. base pay + $0.65/hr.
- >30-50 mi. base pay + $0.85/hr.
- >50 mi. base pay + $1.25/hr.

CONSTRUCTION LABORERS GROUP 3

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$19.50</td>
<td>$8.04</td>
</tr>
<tr>
<td>District 2</td>
<td>$19.50</td>
<td>$8.70</td>
</tr>
<tr>
<td>District 3</td>
<td>$19.00</td>
<td>$7.24</td>
</tr>
<tr>
<td>District 4</td>
<td>$19.00</td>
<td>$7.24</td>
</tr>
</tbody>
</table>

This group includes but is not limited to: Concrete Vibrator; Dumpman (Grader); Equipment Handler; Geotextile and Liners; High-Pressure Nozzlemaster; Jackhammer (Pavement Breaker) Non-Riding Rollers; Pipelayer; Posthole Digger (Power); Power Driven Wheelbarrow; Rigger; Sandblaster; Sod Cutter-Power and Tamper.

Zone Pay:

**Districts 1 & 2**
- 0-30 mi. free zone
- >30-60 mi. base pay + $1.50/hr.
- >60 mi. base pay + $3.90/hr.

**Districts 3 & 4**
- 0-15 mi. free zone
- >15-30 mi. base pay + $0.65/hr.
- >30-50 mi. base pay + $0.85/hr.
- >50 mi. base pay + $1.25/hr.
CONSTRUCTION LABORERS GROUP 4

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$17.14</td>
<td>$6.80</td>
</tr>
<tr>
<td>2</td>
<td>$23.49</td>
<td>$8.70</td>
</tr>
<tr>
<td>3</td>
<td>$22.53</td>
<td>$7.64</td>
</tr>
<tr>
<td>4</td>
<td>$21.02</td>
<td>$8.01</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
Hod Carrier***; Water Well Laborer; Blaster; Wagon Driller; Asphalt Raker; Cutting Torch; Grade Setter; High-Scaler; Power Saws (Faller & Concrete) Powderman; Rock & Core Drill; Track or Truck Mounted Wagon Drill and Welder incl. Air Arc.

***Hod Carriers will receive the same amount of travel and/or subsistence pay as bricklayers when requested to travel.

Zone Pay:
District 1
0-30 mi. free zone
>30-60 mi. base pay + $1.50/hr.
>60 mi. base pay + $3.90/hr.

District 2
0-15 mi. free zone
>15-30 mi. base pay + $1.55/hr.
>30-50 mi. base pay + $3.10/hr.
>50 mi. base pay + $4.65/hr.

Districts 3 & 4
0-15 mi. free zone
>15-30 mi. base pay + $0.65/hr.
>30-50 mi. base pay + $0.85/hr.
>50 mi. base pay + $1.25/hr.

DRYWALL APPLICATORS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$22.00</td>
<td>$11.57</td>
</tr>
<tr>
<td>2</td>
<td>$22.00</td>
<td>$11.86</td>
</tr>
<tr>
<td>3</td>
<td>$22.00</td>
<td>$11.57</td>
</tr>
<tr>
<td>4</td>
<td>$22.00</td>
<td>$11.57</td>
</tr>
</tbody>
</table>

Duties Include:
Drywall and ceiling tile installation.

Zone Pay:
All Districts
0-30 mi. free zone
>30-50 mi. base pay + $4.00/hr.
>50 mi. base pay + $6.00/hr.
**ELECTRICIANS: INCLUDING BUILDING AUTOMATION CONTROL**

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$28.17</td>
<td>$11.80</td>
</tr>
<tr>
<td>District 2</td>
<td>$29.52</td>
<td>$12.76</td>
</tr>
<tr>
<td>District 3</td>
<td>$28.54</td>
<td>$11.61</td>
</tr>
<tr>
<td>District 4</td>
<td>$31.39</td>
<td>$12.72</td>
</tr>
</tbody>
</table>

**Duties Include:**
Electrical wiring; equipment and fixtures; street lights; electrical control systems. Installation and/or adjusting of building automation controls also during testing and balancing, commissioning and retro-commissioning.

**Travel:**

- **District 1**
  - No mileage due when traveling in employer’s vehicle.
  - The following travel allowance is applicable when traveling in employee’s vehicle:
    - 0-10 mi. free zone
    - >10-45 mi. $0.585/mi. in excess of the free zone.
    - >45 mi. $75.00/day

- **District 2**
  - No mileage due when traveling in employer’s vehicle.
  - The following travel allowance is applicable when traveling in employee’s vehicle:
    - 0-08 mi. free zone
    - >08-50 mi. federal mileage rate/mi. in excess of the free zone.
    - >50 mi. $64.00/day

- **District 3**
  - No mileage due when traveling in employer’s vehicle.
  - The following travel allowance is applicable when traveling in employee’s vehicle:
    - 0-08 mi. free zone
    - >08-50 mi. federal mileage rate/mi. in excess of the free zone.
    - >50 mi. $64.00/day

- **District 4**
  - No mileage due when traveling in employer’s vehicle.
  - The following travel allowance is applicable when traveling in employee’s vehicle:
    - 0-18 mi. free zone
    - >18-60 mi. federal mileage rate/mi.
    - >60 mi. $75.00/day

**ELEVATOR CONSTRUCTORS**

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$48.59</td>
<td>$34.08</td>
</tr>
<tr>
<td>District 2</td>
<td>$48.59</td>
<td>$34.08</td>
</tr>
<tr>
<td>District 3</td>
<td>$48.59</td>
<td>$34.08</td>
</tr>
<tr>
<td>District 4</td>
<td>$48.59</td>
<td>$34.08</td>
</tr>
</tbody>
</table>

**Travel:**

- **All Districts**
  - 0-15 mi. free zone
  - >15-25 mi. $38.90/day
  - >25-35 mi. $77.79/day
  - >35 mi. $84.90/day or cost of receipts for hotel and meals, whichever is greater.
FLOOR LAYERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$18.36</td>
<td>No Rate Established</td>
</tr>
<tr>
<td>2</td>
<td>$18.36</td>
<td>No Rate Established</td>
</tr>
<tr>
<td>3</td>
<td>$18.36</td>
<td>No Rate Established</td>
</tr>
<tr>
<td>4</td>
<td>$18.36</td>
<td>No Rate Established</td>
</tr>
</tbody>
</table>

Lay and install carpet from rolls or blocks on floors. Install padding and trim flooring materials.

GLAZIERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$18.50</td>
<td>$3.36</td>
</tr>
<tr>
<td>2</td>
<td>$17.71</td>
<td>$3.16</td>
</tr>
<tr>
<td>3</td>
<td>$16.79</td>
<td>$3.36</td>
</tr>
<tr>
<td>4</td>
<td>$20.33</td>
<td>$3.57</td>
</tr>
</tbody>
</table>

HEATING AND AIR CONDITIONING

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$27.33</td>
<td>$15.39</td>
</tr>
<tr>
<td>2</td>
<td>$27.33</td>
<td>$15.39</td>
</tr>
<tr>
<td>3</td>
<td>$27.33</td>
<td>$15.39</td>
</tr>
<tr>
<td>4</td>
<td>$27.33</td>
<td>$15.39</td>
</tr>
</tbody>
</table>

Duties Include:
Testing and balancing, commissioning and retro-commissioning of all air-handling equipment and duct work.

Travel:
District 1
0-51 mi. free zone
>51 mi.
- $0.25/mi. in employer vehicle
- $0.65/mi. in employee vehicle

Districts 2 & 3
0-40 mi. free zone
>40-80 mi. $30.00/day
>80 mi. $60.00/day
If employer provides transportation, travel pay will be ½ of the amounts listed above unless the employee stays overnight. If the employee chooses to stay overnight, the employee will receive the full amount of travel listed above even if the employer furnishes transportation.

District 4
0-70 mi. free zone
>70 mi.
- $90.00/day if transportation is provided.
- $90.00/day + $0.55/mi. for one trip, there and back if transportation is not provided.

Per Diem:
District 1
$65.00/day
Districts 2, 3 & 4
No per diem established.
### INSULATION WORKERS - MECHANICAL (HEAT AND FROST)

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$27.67</td>
<td>$18.47</td>
</tr>
<tr>
<td>2</td>
<td>$26.55</td>
<td>$18.47</td>
</tr>
<tr>
<td>3</td>
<td>$31.62</td>
<td>$18.47</td>
</tr>
<tr>
<td>4</td>
<td>$27.67</td>
<td>$18.47</td>
</tr>
</tbody>
</table>

**Duties Include:**  
Insulate pipes, ductwork or other mechanical systems.

**Travel:**  
- **All Districts**
  - 0-30 mi. free zone
  - >30-40 mi. $20.00/day
  - >40-50 mi. $30.00/day
  - >50-60 mi. $40.00/day
  - >60 mi. $45.00/day plus  
    - $0.56/mi. if transportation is not provided.
    - $0.20/mi. if in company vehicle.
  - >60 mi. $77.00/day on jobs requiring an overnight stay plus  
    - $0.56/mi. if transportation is not provided.
    - $0.20/mi. if in company vehicle.

### IRONWORKERS - STRUCTURAL STEEL AND REBAR PLACERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$26.90</td>
<td>$20.99</td>
</tr>
<tr>
<td>2</td>
<td>$26.50</td>
<td>$19.98</td>
</tr>
<tr>
<td>3</td>
<td>$26.50</td>
<td>$19.98</td>
</tr>
<tr>
<td>4</td>
<td>$26.50</td>
<td>$19.98</td>
</tr>
</tbody>
</table>

**Duties Include:**  
Structural steel erection; assemble prefabricated metal buildings; cut, bend, tie, and place rebar; energy producing windmill type towers; metal bleacher seating; handrail fabrication and ornamental steel.

**Travel:**  
- **District 1**  
  - 0-45 mi. free zone
  - >45-60 mi. $30.00/day
  - >60-100 mi. $55.00/day
  - >100 mi. $75.00/day
  - Districts 2, 3 & 4  
  - 0-45 mi. free zone
  - >45-85 mi. $45.00/day
  - >85 mi. $75.00/day

### MILLRIGHTS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$31.00</td>
<td>$11.57</td>
</tr>
<tr>
<td>2</td>
<td>$31.00</td>
<td>$11.86</td>
</tr>
<tr>
<td>3</td>
<td>$31.00</td>
<td>$11.57</td>
</tr>
<tr>
<td>4</td>
<td>$31.00</td>
<td>$11.57</td>
</tr>
</tbody>
</table>

**Zone Pay:**  
- **All Districts**  
  - 0-30 mi. free zone
  - >30-50 mi. base pay + $4.00/hr.
  - >50 mi. base pay + $6.00/hr.

### PAINTERS: INCLUDING PAPERHANGERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$23.14</td>
<td>$ 8.11</td>
</tr>
<tr>
<td>2</td>
<td>$23.14</td>
<td>$ 8.11</td>
</tr>
<tr>
<td>3</td>
<td>$19.70</td>
<td>$ 8.11</td>
</tr>
<tr>
<td>4</td>
<td>$19.25</td>
<td>$11.78</td>
</tr>
</tbody>
</table>

**Travel:**  
- **All Districts**  
  - 0-120 mi. free zone
  - >120 mi. $45.00/day
### PILE BUCKS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$28.00</td>
<td>$11.57</td>
</tr>
<tr>
<td>2</td>
<td>$28.00</td>
<td>$11.86</td>
</tr>
<tr>
<td>3</td>
<td>$28.00</td>
<td>$11.57</td>
</tr>
<tr>
<td>4</td>
<td>$28.00</td>
<td>$11.57</td>
</tr>
</tbody>
</table>

**Duties Include:**
Set up crane; set up hammer; weld tips on piles; set leads; insure piles are driven straight with the use of level or plum bob. Give direction to crane operator as to speed and direction of swing. Cut piles to grade.

### PLASTERERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$21.20</td>
<td>$10.68</td>
</tr>
<tr>
<td>2</td>
<td>$21.43</td>
<td>$ 9.41</td>
</tr>
<tr>
<td>3</td>
<td>$23.63</td>
<td>$ 7.19</td>
</tr>
<tr>
<td>4</td>
<td>$21.44</td>
<td>$ 7.14</td>
</tr>
</tbody>
</table>

**Zone Pay:**
- **All Districts**
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $2.95/hr.
  - >60 mi. base pay + $4.75/hr.

### PLUMBERS, PIPEFITTERS, AND STEAMFITTERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$27.53</td>
<td>$13.36</td>
</tr>
<tr>
<td>2</td>
<td>$27.97</td>
<td>$13.73</td>
</tr>
<tr>
<td>3</td>
<td>$27.97</td>
<td>$13.73</td>
</tr>
<tr>
<td>4</td>
<td>$30.21</td>
<td>$16.01</td>
</tr>
</tbody>
</table>

**Duties Include:**
Assemble, install, alter, and repair pipe-lines or pipe systems that carry water, steam, air, other liquids or gases. Testing of piping systems, commissioning and retro-commissioning. Workers in this occupation may also install heating and cooling equipment and mechanical control systems.

**Travel:**
- **District 1**
  - 0-30 mi. free zone
  - >30-50 mi. $20/day
  - >50-75 mi. $35/day
  - >75 mi. $70/day

**Special Provision:**
If transportation is not provided, an additional $0.35/mi. is added to the amounts above for travel at the beginning and end of job, not for every mile traveled.

- **Districts 2 & 3**
  - 0-40 mi. free zone
  - >40-80 mi. $30.00/day
  - >80 mi. $60.00/day

**Special Provision:**
If employer provides transportation, travel pay will be ½ of the amounts listed above unless the employee stays overnight. If the employee chooses to stay overnight, the employee will receive the full amount of travel listed above even if the employer furnishes transportation.

- **District 4**
  - 0-70 mi. free zone
  - >70 mi.
    - $90.00/day if transportation is provided.
    - $90.00/day + $0.55/mi. (for one trip, there and back) if transportation is not provided.
**ROOFERS**

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$17.53</td>
<td>$10.22</td>
</tr>
<tr>
<td>2</td>
<td>$19.68</td>
<td>$ 5.49</td>
</tr>
<tr>
<td>3</td>
<td>$17.31</td>
<td>$ 8.66</td>
</tr>
<tr>
<td>4</td>
<td>$21.28</td>
<td>$ 3.72</td>
</tr>
</tbody>
</table>

**Travel:**
- **District 1**
  - 0-50 mi. free zone
  - >50 mi. $0.30/mi.
- **Districts 2, 3 & 4**
  - No travel established.

**Per Diem:**
- **Districts 2 & 3**
  - Employer pays for room + $25.00/day
- **Districts 1 & 4**
  - No per diem established.

---

**SHEET METAL WORKERS**

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$27.33</td>
<td>$15.39</td>
</tr>
<tr>
<td>2</td>
<td>$27.33</td>
<td>$15.39</td>
</tr>
<tr>
<td>3</td>
<td>$27.33</td>
<td>$15.39</td>
</tr>
<tr>
<td>4</td>
<td>$27.33</td>
<td>$15.39</td>
</tr>
</tbody>
</table>

**Duties Include:**
- Testing and balancing, commissioning and retro-commissioning of all air-handling equipment and duct work. Manufacture, fabrication, assembling, installation, dismantling, and alteration of all HVAC systems, air veyer systems, and exhaust systems. All lagging over insulation and all duct lining. Metal roofing.

**Travel:**
- **All Districts**
  - 0-51 mi. free zone
  - >51 mi.
    - $0.25/mi. in employer vehicle
    - $0.65/mi. in employee vehicle

**Per Diem:**
- **All Districts**
  - $65.00/day

---

**SPRINKLER FITTERS**

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$31.16</td>
<td>$18.37</td>
</tr>
<tr>
<td>2</td>
<td>$30.74</td>
<td>$18.37</td>
</tr>
<tr>
<td>3</td>
<td>$30.42</td>
<td>$18.37</td>
</tr>
<tr>
<td>4</td>
<td>$30.71</td>
<td>$18.37</td>
</tr>
</tbody>
</table>

**Duties Include:**
- Duties include but not limited to any and all fire protection systems: Installation, dismantling, inspection, testing, maintenance, repairs, adjustments, and corrections of all fire protection and fire control systems, including both overhead and underground water mains, all piping, fire hydrants, standpipes, air lines, tanks, and pumps used in connection with sprinkler and alarm systems.

**Travel:**
- **All Districts**
  - 0-60 mi. free zone
  - >60-80 mi. $16.50/day
  - >80-100 mi. $26.50/day
  - >100 mi. $80.00/day
TAPERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$23.14</td>
<td>$8.11</td>
</tr>
<tr>
<td>District 2</td>
<td>$23.14</td>
<td>$8.11</td>
</tr>
<tr>
<td>District 3</td>
<td>$23.14</td>
<td>$8.11</td>
</tr>
<tr>
<td>District 4</td>
<td>$23.14</td>
<td>$8.11</td>
</tr>
</tbody>
</table>

Travel:
- **All Districts**
  - 0-120 mi. free zone
  - >120 mi. $45.00/day

TEAMSTERS GROUP 2 (TRUCK DRIVERS)

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$20.81</td>
<td>$9.16</td>
</tr>
<tr>
<td>District 2</td>
<td>$27.69</td>
<td>$9.16</td>
</tr>
<tr>
<td>District 3</td>
<td>$22.58</td>
<td>$9.16</td>
</tr>
<tr>
<td>District 4</td>
<td>$27.69</td>
<td>$9.16</td>
</tr>
</tbody>
</table>

Zone Pay:
- **All Districts**
  - 0-25 mi. free zone
  - >25-50 mi. base pay + $2.50/hr.
  - >50 mi. base pay + $4.00/hr.

This group includes but is not limited to:
- Combination Truck and Concrete Mixer and Transit Mixer
- Dry Batch Trucks
- Distributor Driver
- Dumpman
- Dump Trucks and similar equipment
- Dumpster
- Flat Trucks
- Lumber Carriers
- Lowboys
- Pickup
- Powder Truck Driver
- Power Boom
- Serviceman
- Service Truck/Fuel Truck/Tireperson
- Truck Mechanic
- Trucks with Power Equipment
- Warehouseman, Partsman, Cardex and Warehouse Expeditor
- Water Trucks

TELECOMMUNICATIONS EQUIPMENT INSTALLERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$22.75</td>
<td>$8.60</td>
</tr>
<tr>
<td>District 2</td>
<td>$23.37</td>
<td>$8.60</td>
</tr>
<tr>
<td>District 3</td>
<td>$23.37</td>
<td>$8.60</td>
</tr>
<tr>
<td>District 4</td>
<td>$22.08</td>
<td>$5.71</td>
</tr>
</tbody>
</table>

Travel:
- **All Districts**
  - The federal mileage rate/mi. in effect when travel occurs if using own vehicle.
  - **Per Diem:**
    - **All Districts**
      - Employer pays for meals and lodging up to $65.00/day.
      - When jobsite is located in Big Sky, West Yellowstone and Gardiner, lodging and meals will be provided by the employer for all actual and reasonable expenses incurred.

Duties Include:
- Install voice; sound; vision and data systems.
- This occupation includes burglar alarms, fire alarms, fiber optic systems, and video systems for security or entertainment.

TILE AND MARBLE SETTERS

No Rate Established

Duties Include:
- Apply hard tile, marble, and wood tile to floors, ceilings, and roof decks
SECTION 01 1000
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: Museum of the Rockies Collections & Storage Facility
B. Owner's Name: Montana State University.
C. Architect's Name: Slate Architecture, Inc.
D. The project consists of a new Collections and Storage Facility addition to the Museum of the Rockies. It consists of a two-story footprint of 9,324 sf with a 1,747 sf mezzanine on the second level collections storage for a total of 20,395 sf. The addition is metal panel and brick masonry veneer over insulated concrete form walls. Roof system is a PVC membrane sloped to interior roof drains. Access is via insulated overhead doors, coiling doors and hollow metal doors and frames. All windows are aluminum. Stairs and a material lift connect the floors for movement of artifacts. The mechanical and fire alarm systems will be tied to the existing Museum of the Rockies system. This is a LEED project and anticipating a Silver rating.

E. TO ALL CONTRACTORS OF RECORD: BE ADVISED THAT A COLLECTION OF IRREPLACEABLE 2,000 YEAR OLD ARTIFACTS ARE BEING HOUSED IN THE ADJACENT GALLERY. CONTRACTORS ARE REQUIRED TO AVOID EXCESSIVE VIBRATION AND WILL NEED TO EXERCISE A VERY HIGH STANDARD OF CARE.

1.02 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a Guaranteed Maximum Price (GMP).

1.03 DESCRIPTION OF ALTERATIONS WORK

A. Scope of demolition and removal work is shown on drawings and specified in Section 02 4100.
B. Scope of alterations work is shown on drawings.
C. HVAC: Alter existing system and add new construction, keeping existing in operation.
D. Electrical Power and Lighting: Alter existing system and add new construction, keeping existing in operation.
E. Fire Suppression Sprinklers: Alter existing system and add new construction, keeping existing in operation.
F. Fire Alarm: Alter existing system and add new construction, keeping existing in operation.
G. Telephone: Alter existing system and add new construction, keeping existing in operation.
H. Security System: Alter existing system and add new construction, keeping existing in operation.

1.04 WORK BY OWNER

A. Items noted NIC (Not in Contract) will be supplied and installed by Owner before Substantial Completion. Some items include:
   1. Movable cabinets.
   2. Furnishings.
   3. Small equipment.

1.05 OWNER OCCUPANCY

A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.
B. Owner intends to occupy the Project upon Substantial Completion.
C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
D. Schedule the Work to accommodate Owner occupancy.

1.06 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas noted on Drawings.
B. Work on this contract is expected to be done during regular working hours Monday through Friday. Any variation from this will require prior approval of the Consultant and Owner.

C. All work must be coordinated with MSU at all times and MSU must be informed about any work impacting campus operations 72 hours or 3 working days in advance of work being conducted and shall require MSU approval.

D. General: Limit use of the premises to construction activities in areas indicated; allow for Owner/MSU occupancy and use by the public. Confine operations to areas within contract limits indicated. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.

E. Contractor shall conduct all his work in such a manner as to minimize the inconvenience and disruption of MSU's daily schedule.

F. Confine operations at the site to the areas permitted under the Contract. Portions of the site beyond areas on which work is indicated are not to be disturbed. Conform to site rules and regulations affecting the work while engaged in project construction.

G. Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials to the areas designated on the drawings. If additional storage is necessary, obtain and pay for such storage off-site.

H. Contractor shall establish a staging area for storage of materials and equipment.

I. The Contractor is to coordinate with MSU for the location of the job site trailer office.

J. Keep driveways and entrances serving the premises clear and available to MSU and MSU's employees, staff and visitors at all times, unless otherwise agreed by MSU. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.

K. Utility Outages and Shutdown:
   1. Limit disruption of utility services to hours the building is unoccupied.
   2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
   3. Prevent accidental disruption of utility services to other facilities.

1.07 SPECIFICATION SECTIONS APPLICABLE TO ALL CONTRACTS

A. Unless otherwise noted, all provisions of the sections listed below apply to all contracts. Specific items of work listed under individual contract descriptions constitute exceptions.

B. Section 01 2000 - Price and Payment Procedures.

C. Section 01 2200 - Unit Prices.

D. Section 01 2300 - Alternates.

E. Section 01 3000 - Administrative Requirements.

F. Section 01 4000 - Quality Requirements.

G. Section 01 5000 - Temporary Facilities and Controls.

H. Section 01 5100 - Temporary Utilities.

I. Section 01 5213 - Field Offices and Sheds.

J. Section 01 5500 - Vehicular Access and Parking.

K. Section 01 5813 - Temporary Project Signage.

L. Section 01 7000 - Execution and Closeout Requirements.

M. Section 01 7800 - Closeout Submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION
SECTION 01 2000
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Procedures for preparation and submittal of applications for progress payments.
B. Documentation of changes in Contract Sum and Contract Time.
C. Change procedures.
D. Correlation of Contractor submittals based on changes.
E. Procedures for preparation and submittal of application for final payment.

1.02 SCHEDULE OF VALUES
A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
B. Forms filled out by hand will not be accepted.
C. Submit Schedule of Values electronically via Form 100 within 15 days after date established in Notice to Proceed.
D. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification Section. Identify site mobilization.
E. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
F. Revise schedule to list approved Change Orders, with each Application For Payment.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS
A. Payment Period: Submit at intervals stipulated in the Agreement.
B. Form to be used: Form 101.
C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
D. Forms filled out by hand will not be accepted.
E. For each item, provide a column for listing each of the following:
   1. Item Number.
   2. Description of work.
   4. Previous Applications.
   5. Work in Place and Stored Materials under this Application.
   6. Authorized Change Orders.
   7. Total Completed and Stored to Date of Application.
   8. Percentage of Completion.
   10. Retainage.
F. Execute certification by signature of authorized officer.
G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.
I. Submit an electronic copy in PDF format for each Application for Payment.
J. Include the following with the application:
   1. Construction progress schedule, revised and current as specified in Section 01 3000.
   2. Partial release of liens from major Subcontractors and vendors.
3. Affidavits attesting to off-site stored products.

K. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.04 MODIFICATION PROCEDURES

A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to the Contract Documents.

B. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.

C. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
   1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
   2. Promptly execute the change.

D. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a 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 shall prepare and submit a fixed price quotation within seven days.

E. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors. Document any requested substitutions in accordance with Section 01 6000.

F. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
   1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
   2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
   3. For pre-determined unit prices and quantities, the amount will based on the fixed unit prices.

G. Substantiation of Costs: Provide full information required for evaluation.
   1. On request, provide the following data:
      a. Quantities of products, labor, and equipment.
      b. Taxes, insurance, and bonds.
      c. Overhead and profit.
      d. Justification for any change in Contract Time.
      e. Credit for deletions from Contract, similarly documented.
   2. Support each claim for additional costs with additional information:
      a. Origin and date of claim.
      b. Dates and times work was performed, and by whom.
      c. Time records and wage rates paid.
      d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.

H. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

I. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

K. Promptly enter changes in Project Record Documents.

1.05 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:
   1. All closeout procedures specified in Section 01 7000.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION
SECTION 01 2300
ALTERNATES

PART 1  GENERAL

1.01  SECTION INCLUDES
A. Description of Alternates.

1.02  ACCEPTANCE OF ALTERNATES
A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.03  SCHEDULE OF ALTERNATES
A. Alternate No. 1 - Casework:
1. Base Bid Item: Section 06 4000 Architectural Wood Casework and Drawing number 10 on sheet A7.1 including one sink base, two drawer bases and a countertop as hatch pattern indicates on the drawings.
2. Alternate Item: Section 06 4000 Architectural Wood Casework and Drawing number 10 on sheet A7.1 including all casework that are NOT indicated with a hatch pattern in the drawings.

PART 2  PRODUCTS - NOT USED

PART 3  EXECUTION - NOT USED

END OF SECTION
SECTION 01 3000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Electronic document submittal service.
   B. Preconstruction meeting.
   C. Site mobilization meeting.
   D. Daily Construction Reports
   E. Progress meetings.
   F. Construction progress schedule.
   G. Progress photographs.
   H. Coordination drawings.
   I. Submittals for review, information, and project closeout.
   J. Number of copies of submittals.
   K. Submittal procedures.

1.02 RELATED REQUIREMENTS
   A. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements.
   B. Section 01 7800 - Closeout Submittals: Project record documents.
   C. Section 01 9113 - General Commissioning Requirements: Additional procedures for submittals relating to commissioning.
      1. Where submittals are indicated for review by both Architect and the Commissioning Authority, submit one extra and route to Architect first, for forwarding to the Commissioning Authority.
      2. Where submittals are not indicated to be reviewed by Architect, submit directly to the Commissioning Authority; otherwise, the procedures specified in this section apply to commissioning submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION
3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE
   A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
      1. Besides submittals for review, information, and closeout, this procedure applies to requests for information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
      2. Contractor and Architect are required to use this service.
      3. It is Contractor's responsibility to submit documents in PDF format.
      4. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.
      5. Users of the service need an email address, Internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
      6. Paper document transmittals will not be reviewed; emailed PDF documents will not be reviewed.
7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Cost: The cost of the service is to be paid by Contractor; include the cost of the service in the contract sum.

C. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
   1. Representatives of Owner are scheduled and included in this training.

D. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 PRECONSTRUCTION MEETING

A. Schedule meeting after award of all bid packages.

B. Attendance Required:
   1. Owner.
   3. Contractor.
   4. Subcontractors.
   5. Owner’s vendors.

C. Agenda:
   1. Execution of Owner-Contractor Agreement.
   2. Submission of executed bonds and insurance certificates.
   4. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
   5. Designation of personnel representing the parties to Contract, Owner, Contractor and Architect.
   6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   7. Scheduling.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 SITE MOBILIZATION MEETING

A. Owner will schedule meeting at the Project site prior to Contractor occupancy.

B. Attendance Required:
   1. Contractor.
   2. Owner.
   3. Contractor’s Superintendent.
   4. Major Subcontractors.

C. Agenda:
   1. Use of premises by Owner and Contractor.
   2. Owner’s requirements and occupancy prior to completion.
   3. Construction facilities and controls provided by Owner.
   4. Temporary utilities provided by Owner.
   5. Survey and building layout.
   7. Schedules.
   8. Application for payment procedures.
   9. Procedures for testing.
   11. Requirements for start-up of equipment.
   12. Inspection and acceptance of equipment put into service during construction period.
D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 PROGRESS MEETINGS

A. Architect will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

B. Attendance Required:
   1. Contractor.
   2. Owner.
   3. Architect.
   4. Special Consultants.
   5. Contractor's Superintendent.

C. Agenda:
   1. Review minutes of previous meetings.
   2. Review of Work progress.
   3. Field observations, problems, and decisions.
   4. Identification of problems that impede, or will impede, planned progress.
   5. Review of submittals schedule and status of submittals.
   6. Review of off-site fabrication and delivery schedules.
   7. Maintenance of progress schedule.
   8. Corrective measures to regain projected schedules.
   9. Planned progress during succeeding work period.
  10. Coordination of projected progress.
  11. Maintenance of quality and work standards.
  12. Effect of proposed changes on progress schedule and coordination.
  13. First Aid
  14. Security
  15. Safety Procedures
  16. Other business relating to Work.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.05 DAILY CONSTRUCTION REPORTS

A. Prepare a daily construction report, recording the following information concerning events at the site; and submit duplicate copies to the Consultant at weekly intervals:
   1. List of subcontractors at the site
   2. Approximate count of personnel at the site
   3. High and low temperatures, general weather conditions
   4. Accidents and unusual events
   5. Meetings and significant decisions
   6. Stoppages, delays, shortages, losses
   7. Meter readings and similar recordings
   8. Emergency procedures
   9. Orders and requests of governing authorities
  10. Change Orders received, implemented
  11. Services connected, disconnected
  12. Equipment or system tests and start-ups
  13. Partial completions, occupancies
  14. Substantial Completions authorized

3.06 CONSTRUCTION PROGRESS SCHEDULE

A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
   1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

3.07 PROGRESS PHOTOGRAPHS

A. Submit new photographs at least once a month, within 3 days after exposure.

B. Maintain one set of all photographs at project site for reference; same copies as submitted, identified as such.

C. Photography Type: Digital; electronic files.

D. Provide photographs of site and construction throughout progress of Work produced by an experienced photographer, acceptable to Architect.

E. In addition to periodic, recurring views, take photographs of each of the following events:
   1. Completion of site clearing.
   2. Excavations in progress.
   3. Foundations in progress and upon completion.
   4. Structural framing in progress and upon completion.
   5. Enclosure of building, upon completion.
   6. Final completion, minimum of ten (10) photos.

F. Take photographs as evidence of existing project conditions as follows:
   1. Interior views: at fire riser, data panel and upper gallery.
   2. Exterior views: south wall at new opening(s) areas.

G. Views:
   1. Provide non-aerial photographs from four cardinal views at each specified time, until Date of Substantial Completion.
   2. Consult with Architect for instructions on views required.
   3. Provide factual presentation.
   4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

H. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
   1. Delivery Medium: Via email.
   2. File Naming: Include project identification, date and time of view, and view identification.
   3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.

3.08 COORDINATION DRAWINGS

A. Provide information required by Project Coordinator for preparation of coordination drawings.

B. Review drawings prior to submission to Architect.

3.09 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
C. Samples will be reviewed only for aesthetic, color, or finish selection.
D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

3.10 SUBMITTALS FOR INFORMATION
A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. LEED submittals and reports.
   3. Certificates.
   4. Test reports.
   5. Inspection reports.
   6. Manufacturer's instructions.
   7. Manufacturer's field reports.
   8. Other types indicated.
B. Submit for Architect's knowledge as contract administrator or for Owner. No action will be taken.

3.11 SUBMITTALS FOR PROJECT CLOSEOUT
A. Submit Correction Punch List for Substantial Completion.
B. Submit Final Correction Punch List for Substantial Completion.
C. When the following are specified in individual sections, submit them at project closeout:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   5. Other types as indicated.
D. Submit for Owner's benefit during and after project completion.

3.12 NUMBER OF COPIES OF SUBMITTALS
A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

3.13 SUBMITTAL PROCEDURES
A. Shop Drawing Procedures:
   1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related Work.
   2. Do not reproduce the Contract Documents to create shop drawings.
   3. Generic, non-project specific information submitted as shop drawings do not meet the requirements for shop drawings.
B. Transmit each submittal with a copy of approved submittal form.
C. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
D. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.
E. 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 the requirements of the Work and Contract Documents.
F. Schedule submittals to expedite the Project, and coordinate submission of related items.

G. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.

H. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.

I. Provide space for Contractor and Architect review stamps.

J. When revised for resubmission, identify all changes made since previous submission.

K. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

L. Submittals not requested will not be recognized or processed.

END OF SECTION
SECTION 01 3610
SUSTAINABLE DESIGN REQUIREMENTS - LEED FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS

PART 1 GENERAL

1.01 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.

1.02 SUMMARY
A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain LEED Silver certification based on USGBC's "LEED 2009 for New Construction & Major Renovations."
1. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
3. A copy of the LEED Project checklist is attached at the end of this Section for information only.
B. Related Requirements:
1. Divisions 1 through 16 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.

1.03 DEFINITIONS
A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
B. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
C. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Respond to questions and requests from Architect and the USGBC regarding LEED credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until the USGBC has made its determination on the project's LEED certification application. Document responses as informational submittals.

1.05 ACTION SUBMITTALS
A. General: Submit additional LEED submittals required by other Specification Sections.
B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.

C. LEED Documentation Submittals:
   1. Credit EA 5: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption performance over a period of time of not less than one year of post construction occupancy.
   2. Credit MR 2: Comply with Division 1 Section "Construction Waste Management."
   3. Credit MR 3: Receipts for salvaged and refurbished materials used for Project, indicating sources and costs for salvaged and refurbished materials.
   4. Credit MR 4: Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating cost for each product having recycled content.
   5. Credit MR 5: Product data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
   7. Credit EQ 3.1:
      a. Construction indoor-air-quality management plan.
      b. Product data for temporary filtration media.
      c. Product data for filtration media used during occupancy.
      d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
   8. Credit IEQ 3.2:
      a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
      b. Product data for filtration media used during flush-out and during occupancy.
      c. Report from testing and inspecting agency indicating results of indoor-air-quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.
   9. Credit IEQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used.
   10. Credit IEQ 4.2: Product data for paints and coatings used inside the weatherproofing system indicating VOC content of each product used.
   11. Credit IEQ 4.4: Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

1.06 INFORMATIONAL SUBMITTALS
A. Qualification Data: For LEED coordinator.
   1. LEED Coordinator: Kath Williams + Associates

B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
   1. Plumbing.
   2. Mechanical.
   3. Electrical.
   4. Specialty items such as elevators and equipment.
   5. Wood-based construction materials.
C. LEED Action Plans: Provide preliminary submittals within 30 days of date established for the Notice to Proceed indicating how the following requirements will be met:
   1. Credit MR 2: Waste management plan complying with Division 1 Section "Construction Waste Management."
   2. Credit MR 4: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
   3. Credit MR 5: List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
   4. Credit MR 7: List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.
   5. Credit IEQ 3.1: Construction indoor-air-quality management plan.

D. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:
   1. Credit MR 2: Waste reduction progress reports complying with Division 1 Section "Construction Waste Management."
   2. Credit MR 4: Recycled content.
   3. Credit MR 5: Regional materials.
   4. Credit MR 7: Certified wood products.

1.07 QUALITY ASSURANCE
A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to coordinate LEED requirements. LEED coordinator may also serve as waste management coordinator.
   1. LEED Requirements Coordinator: Kath Williams, Kath Williams + Associates
   2. Waste Management Coordinator: Hattie Redmon, Jackson Contractor Group

PART 2 PRODUCTS
2.01 MATERIALS, GENERAL
A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated.

2.02 RECYCLED CONTENT OF MATERIALS
A. Credit MR 4: Building materials shall have recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content for Project constitutes a minimum of 10 percent of cost of materials used for Project.
   1. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
   2. Do not include plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

2.03 REGIONAL MATERIALS
A. Credit MR 5: Not less than 10 percent of building materials (by cost) shall be regional materials.

2.04 CERTIFIED WOOD
A. Credit MR 7: Not less than 50 percent (by cost) of wood-based materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
   1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:
      a. Rough carpentry.
b. Miscellaneous carpentry.
c. Architectural woodwork.
d. Wood paneling.
e. Wood veneer wall covering.

2.05 LOW-EMITTING MATERIALS

A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system, adhesives and sealants shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Wood Glues: 30 g/L.
   2. Metal-to-Metal Adhesives: 30 g/L.
   3. Plastic Foam Adhesives: 50 g/L.
   4. Carpet Adhesives: 50 g/L.
   5. Cove Base Adhesives: 50 g/L.
   6. Gypsum Board and Panel Adhesives: 50 g/L.
   7. Multipurpose Construction Adhesives: 70 g/L.
   8. Contact Adhesive: 80 g/L.
   9. Structural Glazing Adhesives: 100 g/L.
   10. Single-Ply Roof Membrane Adhesive: 250 g/L.
   11. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine-covered board, metal, unsupported vinyl, rubber, or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
   12. Top and Trim Adhesive: 250 g/L.
   13. Plastic Cement Welding Compounds: 250 g/L.
   14. ABS Welding Compounds: 325 g/L.
   15. CPVC Welding Compounds: 490 g/L.
   16. PVC Welding Compounds: 510 g/L.
   17. Adhesive Primer for Plastic: 550 g/L.
   18. Sheet-Applied Rubber Lining Adhesive: 850 g/L.
   21. Special-Purpose Aerosol Adhesive (All Types): 70 percent by weight.
   22. Other Adhesives: 250 g/L.
   23. Architectural Sealants: 250 g/L.
   24. Nonmembrane Roof Sealants: 300 g/L.
   25. Single-Ply Roof Membrane Sealants: 450 g/L.
   26. Other Sealants: 420 g/L.
   27. Sealant Primers for Nonporous Substrates: 250 g/L.
   28. Modified Bituminous Sealant Primers: 500 g/L.
   29. Other Sealant Primers: 750 g/L.

B. Credit IEQ 4.2: For field applications that are inside the weatherproofing system, paints and coatings shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Flat Paints and Coatings: VOC not more than 50 g/L.
   2. Nonflat Paints and Coatings: VOC not more than 150 g/L.
   3. Dry-Fog Coatings: VOC not more than 400 g/L.
   4. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
   5. Anticorrosive and Antitrust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
   6. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
   7. Pretreatment Wash Primers: VOC not more than 420 g/L.
   8. Floor Coatings: VOC not more than 100 g/L.

C. Credit IEQ 4.4: Composite wood, agrifiber products, and adhesives shall not contain urea-formaldehyde resin.
PART 3 EXECUTION

3.01 REFRIGERANT AND CLEAN-AGENT FIRE-EXTINGUISHING-AGENT REMOVAL
   A. Prerequisite EA 3: Remove CFC-based refrigerants from existing HVAC&R equipment indicated to remain and replace with refrigerants that are not CFC based. Replace or adjust existing equipment to accommodate new refrigerant as described in Division 15 Sections.
   B. Credit EA 4: Remove clean-agent fire-extinguishing agents that contain HCFCs or halons and replace with agent that does not contain HCFCs or halons. See Division 13 Section "Clean-Agent Fire-Extinguishing Systems" for additional requirements.

3.02 MEASUREMENT AND VERIFICATION
   A. Credit EA 5: Implement measurement and verification plan consistent with Option D: Calibrated Simulation, Savings Estimation Method 2 in the EVO’s “International Performance Measurement and Verification Protocol (IPMVP), Volume III: Concepts and Options for Determining Energy Savings in New Construction,” and as further defined by the following:
   B. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements.
   C. Evaluate energy performance and efficiency by comparing actual to predicted performance.
   D. Measurement and verification period shall cover at least one year of post construction occupancy.

3.03 CONSTRUCTION WASTE MANAGEMENT
   A. Credit MR 2: Comply with Division 1 Section "Construction Waste Management."

3.04 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT
   A. Credit IEQ 3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
      1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 1 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
      2. Replace all air filters immediately prior to occupancy.
   B. Credit IEQ 3.2: Comply with one of the following requirements:
      1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.
         a. <Insert operating requirements>.
      2. Air-Quality Testing:
         a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "Green Building Design and Construction Reference Guide."
         b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
            1) Formaldehyde: 27 ppb.
            2) Particulates (PM10): 50 micrograms/cu. m.
            3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
            4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
            5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
         c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all
requirements have been met. When retesting noncomplying building areas, take samples from same locations as in the first test.

d. Air-sample testing shall be conducted as follows:

1) All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.

2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Non-fixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.

3) Number of sampling locations varies depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.

4) Air samples shall be collected between 3 and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

END OF SECTION
SECTION 01 4000
QUALITY REQUIREMENTS

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Submittals.
B. Quality assurance.
C. References and standards.
D. Testing and inspection agencies and services.
E. Control of installation.
F. Mock-ups.
G. Tolerances.
H. Manufacturers’ field services.
I. Defect Assessment.

1.02 RELATED REQUIREMENTS
A. Section 01 3000 - Administrative Requirements: Submittal procedures.
B. Section 01 6000 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of test/inspection.
      h. Date of test/inspection.
      i. Results of test/inspection.
j. Conformance with Contract Documents.
k. When requested by Architect, provide interpretation of results.

2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.

D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
   1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
   1. Submit report in duplicate within 30 days of observation to Architect for information.
   2. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

G. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
   1. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
   2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications:
   1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time specialist and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
   3. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.

1.06 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Obtain copies of standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.
1.07 TESTING AND INSPECTION AGENCIES AND SERVICES
   A. Owner will employ and pay for services of an independent testing agency to perform other specified testing.
   B. Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
   C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
   D. Contractor Employed Agency:
      2. Laboratory: Authorized to operate in Montana.
      3. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
      4. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 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. Should 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. Have Work performed by persons qualified to produce required and specified quality.
   F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
   G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS
   A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
   B. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
   C. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
   D. Accepted mock-ups shall be a comparison standard for the remaining Work.
   E. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 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. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.

B. Testing Agency Duties:
   1. Test samples of mixes submitted by Contractor.
   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 and inspections required by Architect.
   7. Submit reports of all tests/inspections specified.

C. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.

D. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.
   4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
   5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
   6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

E. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.

F. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and roofing installation as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Architect 30 days in advance of required observations.
   1. Observer subject to approval of Owner.
C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not conforming to specified requirements.

B. If, in the opinion of Owner, it is not practical to remove and replace the Work, Owner will direct an appropriate remedy or adjust payment.

END OF SECTION
SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Temporary telecommunications services.
B. Temporary sanitary facilities.
C. Temporary Controls: Barriers, enclosures, and fencing.
D. Security requirements.
E. Waste removal facilities and services.
F. Project identification sign.

1.02  RELATED REQUIREMENTS

A. Section 01 5100 - Temporary Utilities.
B. Section 01 5500 - Vehicular Access and Parking.

1.03  REFERENCE STANDARDS


1.04  TEMPORARY UTILITIES

A. Owner will provide the following:
   1. Electrical power and metering, consisting of connection to existing facilities.
   2. Water supply, consisting of connection to existing facilities.
B. Use trigger-operated nozzles for water hoses, to avoid waste of water.

1.05  TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
B. Telecommunications services shall include:
   1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
   2. Internet Connections: Minimum of one; Cable modem or faster.

1.06  TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
B. Maintain daily in clean and sanitary condition.

1.07  BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
C. Provide protection for plants designated to remain. Replace damaged plants.
D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.08  FENCING

A. Construction: Contractor's option.
B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.09 INTERIOR ENCLOSURES
A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
B. Construction: Framing and gypsum board sheet materials with closed joints and sealed edges at intersections with existing surfaces:
   1. STC rating of 35 in accordance with ASTM E90.
   2. Maximum flame spread rating of 75 in accordance with ASTM E84.
C. Paint surfaces exposed to view from Owner-occupied areas.

1.10 SECURITY
A. Provide security and facilities to protect Work, existing facilities, and Owner’s operations from unauthorized entry, vandalism, or theft.

1.11 VEHICULAR ACCESS AND PARKING - SEE SECTION 01 5500

1.12 WASTE REMOVAL
A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.
B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
C. Provide containers with lids. Remove trash from site weekly.
D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.13 PROJECT IDENTIFICATION
A. Provide project identification sign of design and construction indicated on Drawings.
B. Erect on site at location established by Architect.
C. No other signs are allowed without Owner permission except those required by law.

1.14 FIELD OFFICES
A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack and drawing display table.
B. Provide space for Project meetings, with table and chairs to accommodate 8 persons.
C. Locate offices a minimum distance of 30 feet from existing and new structures.

1.15 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS
A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
C. Clean and repair damage caused by installation or use of temporary work.
D. Restore existing facilities used during construction to original condition.
E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION
SECTION 01 5500
VEHICULAR ACCESS AND PARKING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Access roads.
B. Parking.
C. Existing pavements and parking areas.
D. Permanent pavements and parking facilities.
E. Construction parking controls.
F. Flag persons.
G. Flares and lights.
H. Haul routes.
I. Traffic signs and signals.
J. Maintenance.
K. Removal, repair.
L. Mud from site vehicles.

1.02 RELATED REQUIREMENTS
A. Section 01 1000 - Summary: access to site, work sequence, and occupancy.
B. Section 31 2200 - Grading: Specifications for earthwork and paving bases.

PART 2 PRODUCTS

2.01 MATERIALS
A. Temporary Construction: Contractor's option.
B. Materials for Permanent Construction: As specified in product specification sections, including earthwork, paving base, and topping.

2.02 SIGNS, SIGNALS, AND DEVICES
A. Traffic Cones and Drums, Flares and Lights: As approved by local jurisdictions.
B. Flag Person Equipment: As required by local jurisdictions.

PART 3 EXECUTION

3.01 PREPARATION
A. Clear areas, provide surface and storm drainage of road, parking, area premises, and adjacent areas.

3.02 ACCESS ROADS
A. Use of designated existing on-site streets and driveways for construction traffic is permitted.
B. Tracked vehicles not allowed on paved areas.
C. Extend and relocate as Work progress requires, provide detours as necessary for unimpeded traffic flow.
D. Provide unimpeded access for emergency vehicles. Maintain 20 foot width driveways with turning space between and around combustible materials.
E. Provide and maintain access to fire hydrants free of obstructions.

3.03 PARKING AND SITE ACCESS
A. MSU Bozeman Vehicle Regulations state: "All students, faculty, staff, and visitors must register any motor vehicle they park on the University campus, for any reason. A visitor is anyone not defined as student, staff or faculty."
B. All Contractor and Contractor employees shall comply with Montana State University parking regulations. MSU parking permits can be purchased at the University Police Office located in the Huffman Building at Seventh Avenue and Kagy Boulevard. Violators of MSU Bozeman Vehicle Regulations may be ticketed and towed.

C. A maximum of three (3) Contractor Permits (or as agreed with MSU) will be made available to the Contractor for parking of essential vehicles within the designated parking lot (as designated on the Cover Sheet of the Contract Documents). Essential vehicles are vehicles used for delivery of equipment and tools required to be parked in close proximity to the construction area. All allowed vehicles only to be parked on hard surfaced areas within the Staging Area. All other Contractor and Contractor employee vehicles on campus shall be parked in designated parking lots to be agreed with MSU. No personal vehicles shall be parked at the project site in any event. If a driver of a vehicle not allowed to be parked at the project site must unload equipment, tools, or materials, the vehicle must be immediately thereafter move to a designated lot or leave campus.

D. Access and egress to and from the project site shall be north on South 11th and Kagy to South 19th Avenue only. In cases where a different route must be used for a specific purpose, permission must be obtained from MSU. Access routes are for delivery of equipment, tools, and materials and not for parking.

E. The site Staging Areas for materials and equipment are designated in the Contract Documents. Staged materials and equipment must be secured on the ground surface or in trailers. Site staging areas shall be fenced in accordance with the Contract Documents. Vehicles in addition to those allowed to be parked may not be used for staging of equipment, tools, or materials

3.04 PERMANENT PAVEMENTS AND PARKING FACILITIES
A. Prior to Substantial Completion the base for permanent roads and parking areas may be used for construction traffic.

B. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.

3.05 FLAG PERSONS
A. Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

3.06 FLARES AND LIGHTS
A. Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

3.07 HAUL ROUTES
A. Consult with authority having jurisdiction, establish public thoroughfares to be used for haul routes and site access.

B. Confine construction traffic to designated haul routes.

C. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

3.08 TRAFFIC SIGNS AND SIGNALS
A. At approaches to site and on site, install at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.

3.09 MAINTENANCE
A. Maintain traffic and parking areas in a sound condition free of excavated material, construction equipment, Products, mud, snow, and ice.

B. Maintain existing 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.

3.10 REMOVAL, REPAIR
A. Repair existing facilities damaged by use, to original condition.
B. Repair damage caused by installation.

3.11 MUD FROM SITE VEHICLES

A. Provide means of removing mud from vehicle wheels before entering streets.

END OF SECTION
SECTION 01 5713
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Prevention of erosion due to construction activities.
B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
C. Restoration of areas eroded due to insufficient preventive measures.
D. Performance bond.
E. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

A. Section 32 1123 - Aggregate Base Courses: Temporary and permanent roadways.

1.03 REFERENCE STANDARDS

G. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; current edition.

1.04 PERFORMANCE REQUIREMENTS

A. Comply with all requirements of U.S. Environmental Protection Agency for erosion and sedimentation control, as specified for the National Pollutant Discharge Elimination System (NPDES), Phases I and II, under requirements for the 2003 Construction General Permit (CGP), whether the project is required by law to comply or not.
C. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
D. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
   1. Obtain and pay for permits and provide security required by authority having jurisdiction.
E. Provide to Owner a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.
F. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
G. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
   1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
   2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.

H. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
   1. Control movement of sediment and soil from temporary stockpiles of soil.
   2. Prevent development of ruts due to equipment and vehicular traffic.
   3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

I. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
   1. Prevent windblown soil from leaving the project site.
   2. Prevent tracking of mud onto public roads outside site.
   3. Prevent mud and sediment from flowing onto sidewalks and pavements.
   4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

J. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
   2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.

K. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.

L. Open Water: Prevent standing water that could become stagnant.

M. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Erosion and Sedimentation Control Plan:
   1. Include:
      a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
      b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
      c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
      d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
      e. Other information required by law.
      f. Format required by law is acceptable, provided any additional information specified is also included.
   2. Obtain the approval of the Plan by authorities having jurisdiction.
3. Obtain the approval of the Plan by Owner.

C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.

D. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

PART 2 PRODUCTS

2.01 MATERIALS

A. Mulch: Use one of the following:
   1. Straw or hay.
   2. Erosion control matting or netting.

B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.

C. Bales: Air dry, rectangular straw bales.
   1. Cross Section: 14 by 18 inches, minimum.
   2. Bindings: Wire or string, around long dimension.

D. Bale Stakes: One of the following, minimum 3 feet long:
   1. Steel U- or T-section, with minimum mass of 1.33 lb per linear foot.
   2. Wood, 2 by 2 inches in cross section.

E. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
   1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
   2. Permittivity: 0.05 sec^-1, minimum, when tested in accordance with ASTM D4491.
   3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
   4. Tensile Strength: 100 lb-f, minimum, in cross-machine direction; 124 lb-f, minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
   5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
   6. Tear Strength: 55 lb-f, minimum, when tested in accordance with ASTM D4533.
   7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.

F. Silt Fence Posts: One of the following, minimum 5 feet long:
   1. Steel U- or T-section, with minimum mass of 1.33 lb per linear foot.

G. Gravel: See Section 32 1123 for aggregate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.

B. Construction Entrances: Traffic-bearing aggregate surface.
   1. Width: As required; 20 feet, minimum.
   2. Length: 50 feet, minimum.
   3. Provide at each construction entrance from public right-of-way.
4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.

C. Linear Sediment Barriers: Made of silt fences.
   1. Provide linear sediment barriers:
      a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
      b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
      c. Along the toe of cut slopes and fill slopes.
      d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart.
      e. Across the entrances to culverts that receive runoff from disturbed areas.
   2. Space sediment barriers with the following maximum slope length upslope from barrier:
      a. Slope of Less Than 2 Percent: 100 feet.
      b. Slope Between 2 and 5 Percent: 75 feet.
      c. Slope Between 5 and 10 Percent: 50 feet.
      d. Slope Between 10 and 20 Percent: 25 feet.
      e. Slope Over 20 Percent: 15 feet.

D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
   1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
   2. Straw bale row blocking entire inlet face area; anchor into pavement.

E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.

F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.

G. Soil Stockpiles: Protect using one of the following measures:
   1. Cover with polyethylene film, secured by placing soil on outer edges.
   2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.

H. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.

I. Temporary Seeding: Use where temporary vegetated cover is required.

3.04 INSTALLATION

A. Traffic-Bearing Aggregate Surface:
   1. Excavate minimum of 6 inches.
   2. Place geotextile fabric full width and length, with minimum 12 inch overlap at joints.
   3. Place and compact at least 6 inches of 1.5 to 3.5 inch diameter stone.

B. Silt Fences:
   1. Store and handle fabric in accordance with ASTM D4873.
   2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch high barriers with minimum 36 inch long posts spaced at 6 feet maximum, with fabric embedded at least 4 inches in ground.
   3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch high barriers, minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
   4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet, use nominal 32 inch high barriers with woven wire reinforcement and steel posts spaced at 4 feet maximum, with fabric embedded at least 6 inches in ground.
   5. Install with top of fabric at nominal height and embedment as specified.
7. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
9. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.

C. Straw Bale Rows:
1. Install bales in continuous rows with ends butting tightly, with one bale at each end of row turned uphill.
2. Install bales so that bindings are not in contact with the ground.
3. Embed bales at least 4 inches in the ground.
4. Anchor bales with at least two stakes per bale, driven at least 18 inches into the ground; drive first stake in each bale toward the previously placed bale to force bales together.
5. Fill gaps between ends of bales with loose straw wedged tightly.
6. Place soil excavated for trench against bales on the upslope side of the row, compacted.

D. Mulching Over Large Areas:
1. Dry Straw and Hay: Apply 2-1/2 tons per acre; anchor using dull disc harrow or emulsified asphalt applied using same spraying machine at 100 gallons of water per ton of mulch.
2. Erosion Control Matting: Comply with manufacturer’s instructions.

E. Mulching Over Small and Medium Areas:
1. Dry Straw and Hay: Apply 4 to 6 inches depth.
2. Erosion Control Matting: Comply with manufacturer's instructions.

F. Temporary Seeding:
1. When hydraulic seeder is used, seedbed preparation is not required.
2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft.
4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft.
5. Incorporate fertilizer into soil before seeding.
6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep.
7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
8. Repeat irrigation as required until grass is established.

3.05 MAINTENANCE

A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.
B. Repair deficiencies immediately.
C. Silt Fences:
1. Promptly replace fabric that deteriorates unless need for fence has passed.
2. Remove silt deposits that exceed one-third of the height of the fence.
3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
D. Straw Bale Rows:
1. Promptly replace bales that fall apart or otherwise deteriorate unless need has passed.
2. Remove silt deposits that exceed one-half of the height of the bales.
3. Repair bale rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
E. Clean out temporary sediment control structures weekly and relocate soil on site.
F. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.

B. Clean out temporary sediment control structures that are to remain as permanent measures.

C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION
SECTION 01 6000
PRODUCT REQUIREMENTS

PART 1  GENERAL

1.01  SECTION INCLUDES
A. General product requirements.
B. Sustainable design-related product requirements.
C. Re-use of existing products.
D. Transportation, handling, storage and protection.
E. Product option requirements.
F. Substitution limitations and procedures.
G. Procedures for Owner-supplied products.
H. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02  RELATED REQUIREMENTS
A. Document 00 2113 - Instructions to Bidders: Product options and substitution procedures prior to bid date.
B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

1.03  REFERENCE STANDARDS
B. C2C (DIR) - C2C Certified Products Registry; Cradle to Cradle Products Innovation Institute; http://www.c2ccertified.org/products/registry.
C. EN 15804 - Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products; 2012.
D. GreenScreen (LIST) - GreenScreen for Safer Chemicals List Translator; Clean Production Action; www.greenscreenchemicals.org.
E. GreenScreen (METH) - GreenScreen for Safer Chemicals Method v1.2; Clean Production Action; www.greenscreenchemicals.org.
F. HPDC (Tool) - Create an HPD On-Line Tool; Health Product Declaration Collaborative; http://hpdcollaborative.org/manufacturers/.
G. ISO 14025 - Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures; 2006.

1.04  SUBMITTALS
A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers’ standard data to provide information specific to this Project.
B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
   1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

1.05 QUALITY ASSURANCE

A. Cradle-to-Cradle Certified: End use product certified Cradle-to-Cradle v2 Basic or Cradle-to-Cradle v3 Bronze, minimum.

B. Environmental Product Declaration (EPD): Publicly available, critically reviewed life cycle analysis having at least a cradle-to-gate scope.
   2. Better: Industry-wide, generic; compliant with ISO 21930, or with ISO 14044, ISO 14040, ISO 14025, and EN 15804; Type III third-party certification with external verification, in which the manufacturer is recognized as the program operator.
   3. Best: Commercial-product-specific; compliant with ISO 21930, or with ISO 14044, ISO 14040, ISO 14025, and EN 15804; Type III third-party certification with external verification, in which the manufacturer is recognized as the program operator.
   4. Where demonstration of impact reduction below industry average is required, submit both industry-wide and commercial-product-specific declarations; or submit at least 5 declarations for products of the same type by other manufacturers in the same industry.

C. GreenScreen Chemical Hazard Analysis: All ingredients of 100 parts-per-million or greater evaluated using GreenScreen for Safer Chemicals Method v1.2.
   1. Good: GreenScreen List Translator evaluation to identify Benchmark 1 hazards; a Health Product Declaration includes this information.
   2. Better: GreenScreen Full Assessment.
   3. Best: GreenScreen Full Assessment by GreenScreen Licensed Profiler.

D. Health Product Declarations (HPD): Complete, published declaration with full disclosure of known hazards, prepared using the Health Product Declaration Collaborative's "Create an HPD" on-line tool; HPD's with "unknown" listed for any hazard will not be considered acceptable.

E. Manufacturer's Inventory of Product Content: Publicly available inventory of all ingredients identified by name and Chemical Abstract Service Registration Number (CAS RN).
   1. For ingredients considered a trade secret or intellectual property, the name and CAS RN may be omitted, provided the ingredient's role, amount, and GreenScreen Benchmark are given.

F. Recycled Content: Determine percentage of post-consumer and post-industrial (pre-consumer) content separately, using the guidelines contained in 16 CFR 260.13.
   1. Previously used, reused, refurbished, and salvaged products are not considered recycled.
   2. Wood fabricated from timber abandoned in transit to original mill is considered reused, not recycled.
   3. Determine percentage of recycled content of any item by dividing the weight of recycled content in the item by the total weight of all material in the item.
   4. Determine value of recycled content of each item separately, by multiplying the content percentage by the value of the item.
   5. Acceptable Evidence:
      a. For percentage of recycled content, information from manufacturer.
      b. For cost, Contractor's cost data.

G. Source Location: Location of harvest, extraction, recovery, or manufacture; where information about source location is required to be submitted, give the postal address:
   1. In all cases, indicate the location of final assembly.
   2. For harvested products, indicate location of harvest.
   3. For extracted (i.e. mined) products, indicate location of extraction.
   4. For recovered products, indicate location of recovery.
5. For products involving multiple manufacturing steps, provide a description of the process at each step, with location.

6. Acceptable Evidence:
   a. Manufacturer's certification.
   b. Life cycle analysis (LCA) performed by third-party.

H. Sustainably Harvested Wood: Solid wood, wood chips, and wood fiber certified or labeled by an organization accredited by one of the following:
   2. Acceptable Evidence: Copies of invoices bearing the certifying organization’s certification numbers.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

A. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

2.02 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by the Contract Documents.

B. DO NOT USE products having any of the following characteristics:
   1. Made outside the United States, its territories, Canada, or Mexico.
   2. Made using or containing CFC’s or HCFC’s.
   3. Made of wood from newly cut old growth timber.
   4. Containing lead, cadmium, asbestos.

C. Where all other criteria are met, Contractor shall give preference to products that:
   1. If used on interior, have lower emissions, as defined in Section 01 6116.
   2. If wet-applied, have lower VOC content, as defined in Section 01 6116.
   3. Are extracted, harvested, and/or manufactured closer to the location of the project.
   4. Have longer documented life span under normal use.
   5. Result in less construction waste.
   6. Are made of recycled materials.
   7. If made of wood, are made of sustainably harvested wood, wood chips, or wood fiber.
   8. Are Cradle-to-Cradle Certified.
   9. Have a published Environmental Product Declaration (EPD).
   10. Have a published Health Product Declaration (HPD).
   11. Have a published GreenScreen Chemical Hazard Analysis.
   12. Have a published Manufacturer’s Inventory of Chemical Content.

D. Provide interchangeable components of the same manufacture for components being replaced.

2.03 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.
PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES

A. Instructions to Bidders specifies time restrictions for submitting requests for substitutions during the bidding period and the documents required. Comply with requirements specified in Section 00 2113.

B. Architect will consider requests for substitutions only within 15 days after date of Agreement.

C. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

D. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

E. A request for substitution constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension that may subsequently become apparent.
   5. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.

F. 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 the Contract Documents.

G. Substitution Submittal Procedure (after contract award):
   1. Submit two copies of request for substitution for consideration. Limit each request to one proposed substitution.
   2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
   3. The Architect will notify Contractor in writing of decision to accept or reject request.

3.02 OWNER-SUPPLIED PRODUCTS

A. Owner's Responsibilities:
   1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
   2. Arrange and pay for product delivery to site.
   3. On delivery, inspect products jointly with Contractor.
   4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for manufacturers' warranties, inspections, and service.

B. Contractor's Responsibilities:
   1. Review Owner reviewed shop drawings, product data, and samples.
   2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
   3. Handle, store, install and finish products.
   4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

### 3.04 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

H. Comply with manufacturer's warranty conditions, if any.

I. Do not store products directly on the ground.

J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

K. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

L. Prevent contact with material that may cause corrosion, discoloration, or staining.

M. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

N. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION
SECTION 01 6116
VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements for Indoor-Emissions-Restricted products.
B. Requirements for VOC-Content-Restricted products.
C. Requirement for installer certification that they did not use any non-compliant products.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittal procedures.
B. Section 01 3329.07 - Prohibited Content Installer Certification: Form for certifying that no non-compliant products were used.
C. Section 01 4000 - Quality Requirements: Procedures for testing and certifications.
D. Section 01 6000 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.
E. Section 07 9200 - Joint Sealants: Emissions-compliant sealants.

1.03 DEFINITIONS

A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
   1. Interior paints and coatings.
   2. Interior adhesives and sealants, including flooring adhesives.
   3. Flooring.
   4. Products making up wall and ceiling assemblies.
   5. Thermal and acoustical insulation.
B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
   1. Interior paints and coatings.
   2. Interior adhesives and sealants, including flooring adhesives.
C. Interior of Building: Anywhere inside the exterior weather barrier.
D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.
F. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
   1. Concrete.
   2. Clay brick.
   3. Metals that are plated, anodized, or powder-coated.
   4. Glass.

1.04 REFERENCE STANDARDS

D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2007.
E. CHPS (HPPD) - High Performance Products Database; Collaborative for High Performance Schools (CHPS); current edition at www.chps.net/.
F. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Carpet and Rug Institute; Current Edition.
I. SCS (CPD) - SCS Certified Products; Scientific Certification Systems; current listings at www.scscertified.com.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.
C. Installer Certifications Regarding Prohibited Content: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of his products, or 2) that such products used comply with these requirements.

1.06 QUALITY ASSURANCE
A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
   1. Wet-Applied Products: State amount applied in mass per surface area.
   2. Paints and Coatings: Test tinted products, not just tinting bases.
   3. Evidence of Compliance: Acceptable types of evidence are the following;
      a. Current UL (GGG) certification.
      b. Current SCS (CPD) Floorscore certification.
      c. Current SCS (CPD) Indoor Advantage Gold certification.
      d. Current listing in CHPS (HPPD) as a low-emitting product.
      e. Current CRI (GLP) certification.
      f. Test report showing compliance and stating exposure scenario used.
   4. Product data submittal showing VOC content is NOT acceptable evidence.
   5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.
B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Report of laboratory testing performed in accordance with requirements.
      b. Published product data showing compliance with requirements.
      c. Certification by manufacturer that product complies with requirements.
C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
PART 2 PRODUCTS

2.01 MATERIALS

A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.

B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
   1. Inherently Non-Emitting Materials.

C. VOC-Content-Restricted Products: VOC content not greater than required by the following:
   3. Paints and Coatings: Each color; most stringent of the following:
      a. 40 CFR 59, Subpart D.
      b. SCAQMD 1113 Rule.
      c. CARB (SCM).

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.

B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION
SECTION 01 7000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Examination, preparation, and general installation procedures.
   B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.
   C. Pre-installation meetings.
   D. Cutting and patching.
   E. Surveying for laying out the work.
   F. Cleaning and protection.
   G. Starting of systems and equipment.
   H. Demonstration and instruction of Owner personnel.
   I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
   J. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS
   A. Section 01 1000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
   B. Section 01 3000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
   C. Section 01 4000 - Quality Requirements: Testing and inspection procedures.
   D. Section 01 5000 - Temporary Facilities and Controls: Temporary exterior enclosures.
   E. Section 01 5000 - Temporary Facilities and Controls: Temporary interior partitions.
   F. Section 01 5100 - Temporary Utilities: Temporary heating, cooling, and ventilating facilities.
   G. Section 01 7419 - Construction Waste Management and Disposal: Additional procedures for trash/waste removal, recycling, salvage, and reuse.
   H. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties and bonds.
   I. Section 01 7900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
   J. Section 01 9113 - General Commissioning Requirements: Contractor's responsibilities in regard to commissioning.
   K. Section 02 4100 - Demolition: Demolition of whole structures and parts thereof; site utility demolition.
   L. Section 07 8400 - Firestopping.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
      1. On request, submit documentation verifying accuracy of survey work.
      2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in conformance with Contract Documents.
      3. Submit surveys and survey logs for the project record.
   C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
1. Structural integrity of any element of Project.
2. Integrity of weather exposed or moisture resistant element.
3. Efficiency, maintenance, or safety of any operational element.
5. Work of Owner or separate Contractor.
6. Include in request:
   a. Identification of Project.
   b. Location and description of affected work.
   c. Necessity for cutting or alteration.
   d. Description of proposed work and products to be used.
   e. Effect on work of Owner or separate Contractor.
   f. Written permission of affected separate Contractor.
   g. Date and time work will be executed.

D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.05 QUALIFICATIONS
A. For demolition work, employ a firm specializing in the type of work required.
   1. Minimum of three years of documented experience.
B. For survey work, employ a land surveyor registered in Montana and acceptable to Architect.
   Submit evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.

1.06 PROJECT CONDITIONS
A. Use of explosives is not permitted.
B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
E. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
   1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
   2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.
F. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
   4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
G. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
   1. At All Times: Excessively noisy tools and operations will not be tolerated inside the building at any time of day; excessively noisy includes jackhammers, pneumatic hammers, air-operated nail guns, and diesel engines.
   2. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.
   3. Indoors: Limit conduct of especially noisy interior work to the hours of 6 pm to 7 am.
H. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
EXECUTION AND CLOSEOUT REQUIREMENTS

I. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

J. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.07 COORDINATION

A. See Section 01 1000 for occupancy-related requirements.

B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

C. Notify affected utility companies and comply with their requirements.

D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are 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.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

H. 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.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that 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. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.
3.02 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 any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS
A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
B. Require attendance of parties directly affecting, or affected by, work of the specific section.
C. Notify Architect four days in advance of meeting date.
D. Prepare agenda and preside at meeting:
   1. Review conditions of examination, preparation and installation procedures.
   2. Review coordination with related work.
E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK
A. Verify locations of survey control points prior to starting work.
B. Promptly notify Architect of any discrepancies discovered.
C. Contractor shall locate and protect survey control and reference points.
D. Control datum for survey is that established by Owner provided survey.
E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
F. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
H. Utilize recognized engineering survey practices.
I. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
J. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.
K. Periodically verify layouts by same means.
L. Maintain a complete and accurate log of control and survey work as it progresses.
M. On completion of foundation walls and major site improvements, prepare a certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.

3.05 GENERAL INSTALLATION REQUIREMENTS
A. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.
B. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

F. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as shown.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000 in locations indicated on drawings.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
   1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
   2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.

D. Remove existing work as indicated and as required to accomplish new work.
   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
   2. Remove items indicated on drawings.
   3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
   4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
   3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
      a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
      b. Provide temporary connections as required to maintain existing systems in service.
   4. Verify that abandoned services serve only abandoned facilities.
   5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

F. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.

G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
   1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
   2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
   3. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.

H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

I. Refinish existing surfaces as indicated:
   1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
   2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

J. Clean existing systems and equipment.

K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

L. Do not begin new construction in alterations areas before demolition is complete.

M. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-conforming work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.

J. Patching:
1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
2. Match color, texture, and appearance.
3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.08 PROGRESS CLEANING
A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK
A. Protect installed work from damage by construction operations.
B. Provide special protection where specified in individual specification sections.
C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
G. Prohibit traffic from landscaped areas.
H. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

3.10 SYSTEM STARTUP
A. Coordinate with requirements of Section 01 9113 - General Commissioning Requirements
B. Coordinate schedule for start-up of various equipment and systems.
C. Notify Architect and owner seven days prior to start-up of each item.
D. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
E. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
F. Verify that wiring and support components for equipment are complete and tested.
G. Execute start-up under supervision of applicable Contractor personnel and manufacturer’s representative in accordance with manufacturers’ instructions.
H. 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.
I. Submit a written report that equipment or system has been properly installed and is functioning correctly.
3.11 DEMONSTRATION AND INSTRUCTION
A. See Section 01 7900 - Demonstration and Training.

3.12 ADJUSTING
A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.13 FINAL CLEANING
A. Execute final cleaning prior to final project assessment.
B. Use cleaning materials that are nonhazardous.
C. 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.
D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
F. Clean filters of operating equipment.
G. Clean debris from roofs, downspouts, scuppers, overflow drains, area drains, and drainage systems.
H. Clean site; sweep paved areas, rake clean landscaped surfaces.
I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES
A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Owner.
B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
G. Accompany Project Coordinator on Contractor's preliminary final inspection.
H. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
I. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.15 MAINTENANCE
A. Provide service and maintenance of components indicated in specification sections.
B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION
SECTION 01 7419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1  GENERAL

1.01  WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Owner may decide to pay for additional recycling, salvage, and/or reuse based on Landfill Alternatives Proposal specified below.

E. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
   1. Aluminum and plastic beverage containers.
   2. Corrugated cardboard.
   3. Wood pallets.
   4. Clean dimensional wood: May be used as blocking or furring.
   5. Land clearing debris, including brush, branches, logs, and stumps; see Section 31 1000 - Site Clearing for use options.
   6. Asphalt paving: May be recycled into paving for project.
   7. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
   8. Gypsum drywall and plaster.
   10. Carpet, carpet cushion, carpet tile, and carpet remnants, both new and removed: DuPont (http://flooring.dupont.com) and Interface (www.interfaceinc.com) conduct reclamation programs.
   11. Paint.
   12. Mechanical and electrical equipment.

F. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.

G. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements.

H. Methods of trash/waste disposal that are not acceptable are:
   1. Burning on the project site.
   2. Burying on the project site.
   3. Dumping or burying on other property, public or private.
   4. Other illegal dumping or burying.
   5. Incineration, either on- or off-site.

I. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02  RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. Section 01 5000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.
C. Section 01 6000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.

D. Section 01 7000 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

E. Section 31 1000 - Site Clearing: Handling and disposal of land clearing debris.

1.03 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse a construction waste material in some manner on the project site.

K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Landfill Alternatives Proposal: Within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner, submit a projection of trash/waste that will require disposal and alternatives to landfilling, with net costs.
   1. Submit to Architect for Owner's review and approval.
   2. If Owner wishes to implement any cost alternatives, the Contract Price will be adjusted as specified elsewhere.
   3. Include an analysis of trash/waste to be generated and landfill options as specified for Waste Management Plan described below.
   4. Describe as many alternatives to landfilling as possible:
      a. List each material proposed to be salvaged, reused, or recycled.
      b. List the proposed local market for each material.
c. State the estimated net cost resulting from each alternative, after subtracting revenue from sale of recycled or salvaged materials and landfill tipping fees saved due to diversion of materials from the landfill.

5. Provide alternatives to landfilling for at least the following materials:
   a. Concrete.
   b. Bricks.
   c. Concrete masonry units.

C. Once Owner has determined which of the landfill alternatives addressed in the Proposal above are acceptable, prepare and submit Waste Management Plan; submit within 10 calendar days after notification by Architect.

D. Waste Management Plan: Include the following information:
   1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
   2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
   3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
      a. List each material proposed to be salvaged, reused, or recycled.
      b. List the local market for each material.
   4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
   5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
   6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.

E. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
   1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
   2. Submit Report on a form acceptable to Owner.
   3. Landfill Disposal: Include the following information:
      a. Identification of material.
      b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
      c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   4. Recycled and Salvaged Materials: Include the following information for each:
      a. Identification of material, including those retrieved by installer for use on other projects.
      b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
      c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
      e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
   5. Material Reused on Project: Include the following information for each:
PART 2 PRODUCTS

2.01 PRODUCT SUBSTITUTIONS

A. See Section 01 6000 - Product Requirements for substitution submission procedures.

B. For each proposed product substitution, submit the following information in addition to requirements specified in Section 01 6000:
   1. Relative amount of waste produced, compared to specified product.
   2. Cost savings on waste disposal, compared to specified product, to be deducted from the Contract Price.

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

A. See Section 01 3000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. See Section 01 5000 for additional requirements related to trash/waste collection and removal facilities and services.

C. See Section 01 6000 for waste prevention requirements related to delivery, storage, and handling.

D. See Section 01 7000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.

C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

D. Meetings: Discuss trash/waste management goals and issues at project meetings.
   1. Pre-bid meeting.
   2. Pre-construction meeting.
   3. Regular job-site meetings.
   4. Job safety meetings.

E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
   1. As a minimum, provide:
      a. Separate area for storage of materials to be reused on-site, such as wood cut-offs for blocking.
      b. Separate dumpsters for each category of recyclable materials.
c. Recycling bins at worker lunch area.
2. Provide containers as required.
3. Provide temporary enclosures around piles of separated materials to be recycled or salvaged.
4. Provide materials for barriers and enclosures that are nonhazardous, recyclable, or reusable to the maximum extent possible; reuse project construction waste materials if possible.
5. Locate enclosures out of the way of construction traffic.
6. Provide adequate space for pick-up and delivery and convenience to subcontractors.
7. If an enclosed area is not provided, clearly lay out and label a specific area on-site.
8. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION
SECTION 01 7800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Project Record Documents.
B. Operation and Maintenance Data.
C. Warranties and bonds.

1.02 RELATED REQUIREMENTS
A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
B. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.
C. Individual Product Sections: Specific requirements for operation and maintenance data.
D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS
A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
B. Operation and Maintenance Data:
   1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
   2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
   4. Submit two sets of revised final documents in final form within 10 days after final inspection.
C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 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 entries 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.
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 and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first 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.

3.02 OPERATION AND MAINTENANCE DATA
A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES
A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.
   2. Information for re-ordering custom manufactured products.
B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
D. Additional information as specified in individual product specification sections.
E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS
A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.
B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
D. Include color coded wiring diagrams as installed.
E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
G. Provide servicing and lubrication schedule, and list of lubricants required.
H. Include manufacturer’s printed operation and maintenance instructions.
I. Include sequence of operation by controls manufacturer.
J. Provide original manufacturer’s parts list, illustrations, assembly drawings, and diagrams required for maintenance.
K. Provide control diagrams by controls manufacturer as installed.
L. Provide Contractor’s coordination drawings, with color coded piping diagrams as installed.
M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
N. Provide list of original manufacturer’s spare parts, current prices, and recommended quantities to be maintained in storage.
O. Include test and balancing reports.
P. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS
A. Assemble operation and maintenance data into durable manuals for Owner’s personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
H. Text: Manufacturer’s printed data, or typewritten data on 20 pound paper.
I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
J. Arrangement of Contents: Organize each volume in parts as follows:
   1. Project Directory.
   2. Table of Contents, of all volumes, and of this volume.
   3. Operation and Maintenance Data: Arranged by system, then by product category.
      a. Source data.
      b. Product data, shop drawings, and other submittals.
      c. Operation and maintenance data.
d. Field quality control data.
e. Photocopies of warranties and bonds.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

END OF SECTION
SECTION 01 7900
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY
A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
B. Training of Owner personnel in operation and maintenance is required for:
   1. All software-operated systems.
   2. HVAC systems and equipment.
   3. Electrical systems and equipment.
   4. Conveying systems.
   5. Landscape irrigation.
   6. Items specified in individual product Sections.
C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
   1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
   2. Finishes, including flooring, wall finishes, ceiling finishes.
   3. Fixtures and fittings.
   4. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS
A. Section 01 7800 - Closeout Submittals: Operation and maintenance manuals.
B. Section 01 9113 - General Commissioning Requirements: Additional requirements applicable to demonstration and training.

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures; except:
   1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
   2. Submit one copy to the Commissioning Authority, not to be returned.
   3. Make commissioning submittals on time schedule specified by Commissioning Authority.
   4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word 2007 preferred.
B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit to Architect for transmittal to Owner.
   2. Submit to Commissioning Authority for review and inclusion in overall training plan.
   3. Submit not less than four weeks prior to start of training.
   4. Revise and resubmit until acceptable.
   5. Provide an overall schedule showing all training sessions.
   6. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Name of firm and person conducting training; include qualifications.
      d. Intended audience, such as job description.
      e. Objectives of training and suggested methods of ensuring adequate training.
      f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      g. Media to be used, such as slides, hand-outs, etc.
      h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
1. Include applicable portion of O&M manuals.
2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
3. Provide one extra copy of each training manual to be included with operation and maintenance data.

D. Training Reports:
   1. Identification of each training session, date, time, and duration.
   2. Sign-in sheet showing names and job titles of attendees.
   3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
   4. Include Commissioning Authority's formal acceptance of training session.

1.04 QUALITY ASSURANCE
   A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
      1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
      2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL
   A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
   B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
   C. Demonstration may be combined with Owner personnel training if applicable.
   D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
      1. Perform demonstrations not less than two weeks prior to Substantial Completion.
      2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
   E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
      1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL
   A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.
   B. Conduct training on-site unless otherwise indicated.
   C. Owner will provide classroom and seating at no cost to Contractor.
   D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
   E. Provide training in minimum two hour segments.
   F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.
   G. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel “show-up” time.
H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
   1. The location of the O&M manuals and procedures for use and preservation; backup copies.
   2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
   3. Typical uses of the O&M manuals.
I. Product- and System-Specific Training:
   1. Review the applicable O&M manuals.
   2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
   3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
   4. Provide hands-on training on all operational modes possible and preventive maintenance.
   5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
   6. Discuss common troubleshooting problems and solutions.
   7. Discuss any peculiarities of equipment installation or operation.
   8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
   9. Review recommended tools and spare parts inventory suggestions of manufacturers.
  10. Review spare parts and tools required to be furnished by Contractor.
  11. Review spare parts suppliers and sources and procurement procedures.
J. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION
SECTION 01 9113
GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY
A. Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
   1. Verify that the work is installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by Contractor are utilized to achieve this.
   2. Verify and document that functional performance is in accordance with the Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
   3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
   4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.
B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion.
C. The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.
D. The Commissioning Authority is employed by Owner.

1.02 SCOPE OF COMMISSIONING
A. The following are to be commissioned:
   B. Building envelope.
   C. HVAC System, including:
      1. Major and minor equipment items.
      2. Piping systems and equipment.
      3. Ductwork and accessories.
      4. Terminal units.
      5. Control system.
      6. Variable frequency drives.
   D. Electrical Systems:
      1. Power quality.
      2. Uninterruptible power systems.
      3. Lighting controls other than manual switches.
   E. Electronic Safety and Security:
      1. Security system, including doors and hardware.
      2. Fire and smoke alarms.
   F. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

1.03 RELATED REQUIREMENTS
A. Section 01 7800 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.
B. Section 01 7900 - Demonstration and Training: Scope and procedures for Owner personnel training.
C. Section 01 9114 - Commissioning Authority Responsibilities.
1.04 REFERENCE STANDARDS
   A.  CSI/CSC MF - Masterformat; 2014.

1.05 SUBMITTALS
   A.  See Section 01 3000 - Administrative Requirements, for submittal procedures; except:
      1.  Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority, unless they require review by Architect; in that case, submit to Architect first.
      2.  Submit one copy to the Commissioning Authority, not to be returned.
      3.  Make commissioning submittals on time schedule specified by Commissioning Authority.
      4.  Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of Prefunctional Checklists or Functional Test requirements; submit in editable electronic format, Microsoft Word 2010 preferred.
      5.  As soon as possible after submittals made to Architect are approved, submit copy of approved submittal to the Commissioning Authority.
   B.  Manufacturers’ Instructions:  Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.
   C.  Product Data:  If submittals to Architect do not include the following, submit copies as soon as possible:
      1.  Manufacturer's product data, cut sheets, and shop drawings.
      2.  Manufacturer's installation instructions.
      3.  Startup, operating, and troubleshooting procedures.
      4.  Fan and pump curves.
      5.  Factory test reports.
      6.  Warranty information, including details of Owner's responsibilities in regard to keeping warranties in force.
   D.  Startup Plans and Reports.
   E.  Completed Prefunctional Checklists.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT
   A.  Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
   B.  Calibration Tolerances:  Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified.  If not otherwise noted, the following minimum requirements apply:
      1.  Temperature Sensors and Digital Thermometers:  Certified calibration within past year to accuracy of 0.5 degree F and resolution of plus/minus 0.1 degree F.
      2.  Pressure Sensors:  Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
      3.  Calibration:  According to the manufacturer’s recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.
   C.  Equipment-Specific Tools:  Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.
D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
   1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

PART 3 EXECUTION

3.01 COMMISSIONING PLAN

A. Commissioning Authority has prepared the Commissioning Plan.
   1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
   2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.

B. Contractor is responsible for compliance with the Commissioning Plan.

C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.

D. Basis of Design Documentation (BOD): Detailed documentation of the functional requirements of the project; descriptions of the systems, components, and methods chosen to meet the design intent; assumptions underlying the design intent.

E. Commissioning Schedule:
   1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
   2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
   3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
   4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

3.02 DOCUMENTATION IDENTIFICATION SYSTEM

A. Give each submitted form or report a unique identification; use the following scheme.

B. Type of Document: Use the following prefixes:
   1. Startup Plan: SP-.
   2. Startup Report: SR-.
   3. Prefunctional Checklist: PC-.
   4. Functional Test Procedure: FTP-.
   5. Functional Test Report: FTR-.

C. System Type: Use the first 4 digits from CSI/CSC MasterFormat, that are applicable to the system; for example:
   1. 2300: HVAC system as a whole.
   2. 2320: HVAC Piping and Pumps.
   3. 2330: HVAC Air Distribution.

D. Component Number: Assign numbers sequentially, using 1, 2, or 3 digits as required to accommodate the number of units in the system.

E. Test, Revision, or Submittal Number: Number each successive iteration sequentially, starting with 1.

F. Example: PC-2320-001.2 would be the Prefunctional Checklist for equipment item 1 in the HVAC piping system, probably a pump; this is the second, revised submittal of this checklist.

3.03 STARTUP PLANS AND REPORTS

A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.
B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.

C. Submit directly to the Commissioning Authority.

3.04 PREFUNCTIONAL CHECKLISTS

A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
   1. No sampling of identical or near-identical items is allowed.
   2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
   3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
      a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
      b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
      c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
      d. Serial number of installed unit.
      e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer’s start-up checklist items and minor testing.
      f. Sensor and actuator calibration information.
   4. Samples of Prefunctional Checklist forms that indicate anticipated level of detail can be found at http://www.peci.org/library/mcpgs.htm.

B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
   1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
   2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
   3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
   4. If any Checklist line item is not relevant, record reasons on the form.
   5. Contractor may independently perform startup inspections and/or tests, at his option.
   6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
   7. Submit completed Checklists to Commissioning Authority within two days of completion.
   8. See Section 01 7000 - Execution and Closeout Requirements for additional general startup requirements.

C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
   1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in the Contract Documents.
   2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in the Contract Documents or not.
4. When asked to review the proposed Checklists, do so in a timely manner.

D. Commissioning Authority Witnessing: Required for:
   1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
   2. A sampling of non-primary equipment, as allowed by the commissioning plan.

E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
   1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.05 FUNCTIONAL TESTS

A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.

B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.

C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.

D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
   1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents or does not perform properly.
   2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.
   3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
   4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.
   5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.

E. Functional Test Procedures:
   1. Some test procedures are included in the Contract Documents; where Functional Test procedures are not included in the Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
   2. Examples of Functional Testing:
      a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
      b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
c. Systems are run through all the HVAC control system’s sequences of operation and components are verified to be responding as the sequence’s state.

d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.

3. Samples of Functional Test forms that indicate anticipated level of detail can be found at http://www.peci.org/library/mcpgs.htm.

F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor’s responsibility regardless of timing.

G. Factory Tests: Commissioning Authority and Contractor are responsible for coordinating testing of equipment at the factory by factory personnel, to ensure compliance with commissioning requirements.

3.06 SENSOR AND ACTUATOR CALIBRATION

A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gages, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.

B. Calibrate using the methods described below; alternate methods may be used, if approved by Commissioning Authority and Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.

C. All Sensors:
   1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
   2. Verify that sensors with shielded cable are grounded only at one end.
   3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
   4. Tolerances for critical applications may be tighter.

D. Sensors Without Transmitters - Standard Application:
   1. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
   2. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
   3. If not, install offset, calibrate or replace sensor.

E. Sensors With Transmitters - Standard Application.
   1. Disconnect sensor.
   2. Connect a signal generator in place of sensor.
   3. Connect ammeter in series between transmitter and building automation system control panel.
   4. Using manufacturer’s resistance-temperature data, simulate minimum desired temperature.
   5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
   6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
   7. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
   8. Reconnect sensor.
   9. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
   10. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
   11. If not, replace sensor and repeat.
12. For pressure sensors, perform a similar process with a suitable signal generator.

F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
   1. Watthour, Voltage, Amperage: 1 percent of design.
   2. Pressure, Air, Water, Gas: 3 percent of design.
   3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F.
   4. Relative Humidity: 4 percent of design.
   5. Barometric Pressure: 0.1 inch of Hg.
   6. Flow Rate, Air: 10 percent of design.
   7. Flow Rate, Water: 4 percent of design.
   8. AHU Wet Bulb and Dew Point: 2.0 degrees F.
   9. Hot Water Coil and Boiler Water Temperature: 1.5 degrees F.
  10. Cooling Coil, Chilled and Condenser Water Temperatures: 0.4 degrees F.
  11. Natural Gas and Oil Flow Rate: 1 percent of design.

G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.

H. Valve/Damper Stroke Setup and Check:
   1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
   2. Set pump/fan to normal operating mode.
   3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
   4. Command valve/damper to open; verify position is full open and adjust output signal as required.
   5. Command valve/damper to a few intermediate positions.
   6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
   1. With full pressure in the system, command valve closed.
   2. Use an ultra-sonic flow meter to detect flow or leakage.

3.07 TEST PROCEDURES - GENERAL

A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.

C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
   1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
   2. Sampling is not allowed for:
      a. Major equipment.
      b. Life-safety-critical equipment.
      c. Prefunctional Checklist execution.
   3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
   4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
   5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the “first sample.”
6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
7. If YY percent of the units in the second sample fail, test all remaining identical units.
8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.

D. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").

E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.

F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.

G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.

H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.

I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority's request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
2. Other points will be monitored by the Commissioning Authority using dataloggers.
3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
5. Graphical output is desirable and is required for all output if the system can produce it.
6. Monitoring may be used to augment manual testing.

3.08 OPERATION AND MAINTENANCE MANUALS

A. See Section 01 7800 - Closeout Submittals for additional requirements.
B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

END OF SECTION
SECTION 01 9114
COMMISSIONING AUTHORITY RESPONSIBILITIES

PART 1 GENERAL

1.01 SUMMARY

A. Commissioning is intended to achieve the following specific objectives; this section covers the Commissioning Authority’s responsibilities for commissioning:
   1. Verify that the work is installed in accordance with the Contract Documents and the manufacturer’s recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists are utilized to achieve this.
   2. Verify and document that functional performance is in accordance with the Contract Documents: Functional Tests performed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
   3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed O&M data submittals are specified.
   4. Verify that the Owner’s operating personnel are adequately trained: Formal training conducted by Contractor is specified.

B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion.

C. Coordinate and direct all the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.

D. The Commissioning Authority is employed by Owner.

1.02 SCOPE OF COMMISSIONING

A. The following are to be commissioned:
   B. HVAC System, including:
      1. Major and minor equipment items.
      2. Piping systems and equipment.
      3. Terminal units.
      4. Control system.
      5. Vibration control devices.
      6. Variable frequency drives.
   C. Electrical Systems:
      1. Uninterruptible power systems.
      2. Lighting controls other than manual switches.
   D. Electronic Safety and Security:
      1. Security system, including doors and hardware.
      2. Fire and smoke alarms.
   E. Communications:
      1. Voice and data systems.
   F. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

1.03 REFERENCE STANDARDS

A. ASHRAE Guideline 1.1 - The HVAC Commissioning Process; 2012
1.04 SUBMITTALS

A. Commissioning Plan:
   1. Submit preliminary draft for review by Owner and Architect within 30 days after commencement of Commissioning Authority contract.
   2. Submit revised draft to be included in the construction contract documents, not less than 4 weeks prior to bid date.
   3. Submit final plan not more than 90 days after commencement of construction, for issuance to all parties.

B. General Commissioning Specifications:
   1. Submit preliminary draft for review by Owner and Architect at start of construction documents phase or within 30 days after commencement of Commissioning Authority contract, whichever is later.
   2. Submit final draft for review by Owner and Architect not less than 6 weeks prior to bid date.

C. List of Prefunctional Checklists to be developed:
   1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
   2. Submit revised list not less than 6 weeks prior to bid date, for inclusion in the construction contract documents.
   3. Submit final list not more than 60 days after start of construction.

D. Prefunctional Checklists:
   1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
   2. Submit revised draft for review by Owner and Architect not less than 6 weeks prior to bid date, for inclusion in the construction contract documents.
   3. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.

E. List of Functional Test procedures to be developed:
   1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
   2. Submit revised list not less than 6 weeks prior to bid date, for inclusion in the Contract Documents; this is intended to be a list of titles, not full description of the tests.
   3. Submit final list not more than 60 days after start of construction.

F. Functional Test Procedures:
   1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
   2. Submit revised draft for review by Owner and Architect not less than 6 weeks prior to bid date, for inclusion in the construction contract documents.
   3. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.

G. Training Plan.

H. Commissioning Record: Submit to Contractor for inclusion with O&M manuals.

I. Final Commissioning Report: Submit to Owner.

J. Recommissioning Manual: Submit within 60 days after receipt of Owner’s instructions to proceed with preparation.

K. Sustainable Design Documentation: Submit Final Commissioning Report and Recommissioning Manual in accordance with procedures specified in Section 01 3329 - Sustainable Design Reporting.

PART 2 PRODUCTS

2.01 DOCUMENTATION IDENTIFICATION SYSTEM

A. Give each submitted form or report a unique identification; use the following scheme.

MSU#:13-0093

Museum of the Rockies
Collections & Storage Facility
B. Type of Document: Use the following prefixes:
   1. Commissioning Plan: CP-.
   2. Prefunctional Checklist: PC-.
   3. Functional Test Procedure: FTP-.
   4. Functional Test Report: FTR-.
   5. Commissioning Report: CR-.

C. System Type: Use the first 4 digits from CSI/CSC MasterFormat, 2004 Edition, that are applicable to the system; for example:
   1. 2300: HVAC system as a whole.
   2. 2320: HVAC Piping and Pumps.
   3. 2330: HVAC Air Distribution.

D. Component Number: Assign numbers sequentially, using 1, 2, or 3 digits as required to accommodate the number of units in the system.

E. Test, Revision, or Submittal Number: Number each successive iteration sequentially, starting with 1.

F. Example: PC-2320-001.2 would be the Prefunctional Checklist for equipment item 1 in the HVAC piping system, probably a pump; this is the second, revised submittal of this checklist.

PART 3 EXECUTION

3.01 COMMISSIONING PLAN

A. Prepare and maintain the Commissioning Plan, covering commissioning schedule, Prefunctional Checklist and Functional Test procedures, coordination requirements, and forms to be used, for all parties in the commissioning process.
   1. Call and chair meetings of the Commissioning Team when appropriate.
   2. Give Contractor sufficient notice for scheduling commissioning activities.
   3. Develop a comprehensive start-up and initial systems checkout plan with cooperation of Contractor and subcontractors.
   4. The PECI Model Commissioning Plan may be used as a guide for the Commissioning Plan.
   5. ASHRAE Guideline 1 may be used as a guide for the Commissioning Plan.
   6. Avoid replication of information included in the construction contract documents to the greatest extent possible.

B. Basis of Design Documentation: Detailed documentation of the functional requirements of the project; descriptions of the systems, components, and methods chosen to meet the design intent; assumptions underlying the design intent.

C. Review the construction contract documents for Contractor submittals of draft checklists, draft test procedures, manufacturer startup procedures, and other information intended for the use of the Commissioning Authority in preparing the Commissioning Plan.

D. Commissioning Schedule:
   1. Coordinate with Contractor anticipated dates of startup of each item of equipment and system.
   2. Contractor's scheduling responsibilities are specified in the construction contract documents.
   3. Revise and re-issue schedule monthly.
   4. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
   5. Deliver relevant Prefunctional Checklists and Functional Test Procedures to Contractor in time to avoid delay.

E. Commissioning Team: Project manager or other designated person of:
   1. Owner's building or plant operation staff.
   2. Commissioning Authority.
   3. Construction Manager.
4. Design professional's design team.
5. General Contractor.
6. HVAC subcontractor.
7. HVAC control system subcontractor.
8. HVAC testing, adjusting, and balancing (TAB) subcontractor.

3.02 CONSTRUCTION CONTRACT DOCUMENTS

A. General Commissioning Specifications: Prepare general commissioning specifications coordinated with and integrated into the Contract Documents prepared by Architect.
   1. Include general procedures applicable to all types of items to be commissioned and specific procedures for each type of work.
   2. Identify Contractor submittals needed for purposes of commissioning, that are not otherwise required to be submitted.
   3. The PECI Model Commissioning Guide Specifications may be used as a guide.
   4. Use Section 01 9113 - General Commissioning Requirements.

B. Prefunctional Checklists: Develop detailed Checklists for each item to be commissioned.
   1. List of Checklists to be Developed: Prepare and maintain a detailed list of titles, not full text.
   2. The Checklist forms are intended to be part of the Contractor's Contract Documents.

C. Functional Testing: Develop detailed procedures for each item to be commissioned; submit for review by Owner and Architect.
   1. List of Test Procedures to be Developed: Prepare and maintain a detailed list of titles, not full text.
   2. The forms the Commissioning Authority will use to report Functional Test results are not intended to be part of Contractor's Contract Documents, but the Functional Test Procedures that must be executed by the Contractor must be made part of the Contract Documents, by modification if necessary.

D. Develop any other reporting forms Contractor will be required to use; if they are likely to require a substantially different amount of work than the Contractor can reasonably anticipate, they must be included in the construction contract documents.

E. If any part of the documents described above have not been developed by the bid date, coordinate with Architect the issuance of modifications to the construction contract documents.

3.03 PREFUNCTIONAL CHECKLISTS

A. Prefunctional Checklists - Content: Prepare forms for Contractor's use, in sufficient detail to document that the work has been installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup.
   1. Prepare separate Checklists for each type of equipment, system, or other assembly, customized to the item.
   2. Identify each Checklist by using the contract documents identification number or name, if any; if none, create unique identifiers for each Checklist; do not rely on Contractor to number checklists.
   3. Multiple identical or near-identical items may appear on a single Checklist provided there is space to record all required data for each separately; label each set of data uniquely.
   4. Include space to record manufacturer name, model number, serial number, capacity and other relevant characteristics, and accessories and other features as applicable; include space to record "as specified", "as submitted", and "as installed" data.
   5. Include space to record whether or not the required submittals have been received; list each separate type of submittal.
   6. Include line items for each physical inspection to be performed.
   7. Include line items for each operational inspection to be performed, such as checking switch operation, fan rotation, valve and damper stroke, and measuring actual electrical loads.
8. Include separate section for sensors and actuators, with space for documenting actual physical location and calibration measurements; provide a separate generic calibration checklist identified wherever referenced.

9. Include spaces to record that related Checklists for related work upon which this work depends have been completed.

B. Prefunctional Checklists - Format:
   1. Provide a cover sheet showing name of equipment item or system, documentation identification number (see Documentation Identification Scheme), names of accessory components involved, and identification of related checklists.
   2. Include on cover sheet space for Contractor's use in attesting to completeness; provide spaces for the signatures of the general contractor and each subcontractor or other entity responsible, customized to the project and the type of item.
   3. Include on the cover sheet, above the signature block, the following statement: "The work referenced in this Checklist and other work integral to or dependent on this work is complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event." Include two checkboxes:
      a. "This Checklist is submitted for approval with no exceptions."
      b. "This Checklist is submitted for approval, subject to the attached list of outstanding items, none of which preclude the performance of safe and reliable functional tests. A statement of completion will be submitted upon completion of the outstanding items."
   4. Use a consistent, tabular format for all Checklists, with one line per checklist activity.
   5. For each line item, provide space for initials and date, and identification of the subcontractor or other entity responsible.

3.04 FUNCTIONAL TEST PROCEDURES

A. Develop test procedures in sufficient detail to show that functional performance is in accordance with the Contract Documents and shows proper operation through all modes of operation where there is a different system response, including seasonal, unoccupied, warm-up, cool-down, part- and full-load.
   1. Obtain assistance and review by installing subcontractors.
   2. Itemize each test sequence in step-by-step order, with acceptance criteria for each step and for the test as a whole.
   3. Include test setup instructions, description of tools and apparatus, special cautions, and.
   4. Avoid procedures that would void or otherwise limit warranties; review with Contractor prior to execution.
   5. For HVAC systems, procedures may include energy management control system trending, stand-alone datalogger monitoring or manual functional testing.
   6. Obtain explicit approval of Contractor in regard to feasibility and safety prior to execution.

B. Functional Test Report Forms: Prepare forms in advance of testing, using a consistent format; include all test procedure information given to Contractor and:
   1. Report Identifier (see Documentation Identification Scheme).
   2. Test prerequisites.
   3. Formulas to be used in calculations.
   4. Yes/No check boxes for each step of test.
   5. Space to record results, document deficiencies, and make recommendations.
   6. Signature and date block for Commissioning Authority.

C. Functional Test Prerequisites: Include space to verify all of the following items on each Functional Test Report Form, unless truly inapplicable:
   1. All related equipment has been started up and start-up reports and Prefunctional Checklists submitted and approved ready for Functional Testing.
      a. For hydronic systems, check that:
         1) Piping system flushing is complete and required report approved.
         2) Water treatment system is complete and operational.
3) Test and balance (TAB) is complete and approved.

2. All control system functions for this and all interlocking systems are programmed and operable in accordance with the Contract Documents, including final set points and schedules with debugging, loop tuning and sensor calibrations completed, with space for signature of controls installer.

3. Incomplete items identified by Architect during closeout inspections have been corrected or completed.

4. Safeties and operating ranges have been reviewed.

5. A copy of the specified sequence of operation is attached.

6. A copy of applicable schedules and setpoints is attached.

7. A copy of the specified Functional Test Procedures is attached.

8. The Functional Test Procedures have been reviewed and approved by the applicable installer.

9. Vibration control report approved (if required).

10. False loading equipment, system and procedures ready.

11. Sufficient clearance around equipment for servicing.

12. Original values of pre-test setpoints that need to be changed to accommodate testing have been recorded, with a check box provided to verify return to original values (include control parameters, limits, delays, lockouts, schedules, etc.).

13. Any other items on the Prefunctional Checklist or Start-up Reports that need to be re-verified.

3.05 CONSTRUCTION PHASE

A. Coordinate the commissioning work with Contractor and Construction Manager, ensure that commissioning activities are being incorporated into the master schedule.

B. Perform site visits, as necessary, to observe component and system installations. Attend planning and job-site meetings to obtain information on construction progress. Review Contractor's meeting minutes for issues relating to the commissioning process. Assist in resolving discrepancies.

C. Commissioning Kick-Off Meeting: Plan and conduct a meeting early in the construction phase to review commissioning activities and responsibilities with all parties involved. Require attendance by all members of the Commissioning Team.

D. Conduct periodic meetings as necessary to coordinate, resolve planning issues, and aid in resolution of deficiencies, minimizing the time spent by Contractor and Owner personnel; hold meetings at least monthly.

E. Submit periodic progress reports to Owner and Contractor.

F. Review Contractor shop drawing submittals applicable to systems being commissioned for compliance with commissioning needs; verify that Owner's responsibilities are clearly defined in warranties.

G. Review and approve submittals directly related to commissioning.

H. Deliver Prefunctional Checklists and Functional Test procedures to Contractor.

I. Verify satisfactory completion of Prefunctional Checklists by Contractor by reviewing checklists and by site observation and spot checking; provide formal approval when satisfactory.

J. Verify startup of all systems by reviewing start-up reports and by site observation; provide formal approval when satisfactory.

K. Coordinate, witness and approve Functional Tests performed by Contractor. Coordinate retesting until satisfactory performance is achieved.

L. HVAC Commissioning:

1. Gather and review the control sequences and interlocks and work with Contractor and design engineers until sufficient clarity has been obtained, in writing, to be able to prepare detailed Functional Test procedures.
2. Witness all or part of HVAC piping test and flushing procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.

3. Witness all or part of duct testing and cleaning procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.

4. Review TAB Plan prepared by Contractor.

5. Before TAB is executed, witness sufficient Functional Testing of the control system to approve it to be used for TAB.

6. Verify air and water systems balancing by spot testing, by reviewing completed reports, and by site observation; provide formal approval when satisfactory.

7. Analyze trend logs and monitoring data to verify performance.

8. Prepare a standard trend logging package of primary parameters that will provide Owner's operations staff clear indications of system function in order to identify proper system operation and trouble shoot problems; provide any additional information needed to interpret the trend logs.

M. Witness and document testing of systems and components over which the Commissioning Authority does not have direct control, such as smoke control systems, tests contracted directly by Owner, and tests by manufacturer's personnel; include documentation in O&M manuals.

N. When Functional Testing for specific systems or equipment is specified to be performed by the Commissioning Authority rather than the Contractor, perform such testing without assistance of Contractor.

O. Maintain a master deficiency and resolution log and a separate testing record. Provide written progress and test reports with recommended actions.

P. O&M Data: Review submitted operation and maintenance data for completeness; provide formal approval if satisfactory.

Q. Notify Contractor and Owner of deficiencies in procedures or results; suggest solutions.

3.06 TRAINING

A. Training Plan: Prepare a comprehensive Training Plan, incorporating draft training plans submitted by Contractor.

1. Include a four hour session by the HVAC design engineer covering the overall HVAC system and equipment design concepts, with one-line schematic drawings.

2. Include a four hour session by the Commissioning Authority on the use of the blank Prefunctional Checklists and Functional Test report forms for re-commissioning purposes.

3. Establish criteria for determining satisfactory completion of training.

B. Verify that training was satisfactorily completed; provide formal approval if satisfactory.

3.07 CLOSEOUT

A. Commissioning Record: Use the same format and organization as specified for the O&M manuals.

1. Include the Final Commissioning Plan and Final Report.

2. For each product or system and equipment item, include the following organized as indicated, with separator tabs:
   a. Design intent documentation, furnished by Architect or others.
   b. Detailed operational sequences.
   c. Startup plan and approved startup reports.
   d. Filled out Prefunctional Checklists.
   e. Filled out Functional Test reports; trend logs and monitoring reports and analysis; other verification documentation.
   f. Training plan and training records.
   g. Reconciliation recommendations, including time schedule and procedures; include blank copies of all Prefunctional Checklists and Functional Test report forms.

B. Final Commissioning Report: Include:
1. Executive summary.
2. List of participants and roles.
4. Overview of commissioning scope and general description of testing and verification methods.
5. For each item commissioned, an evaluation of adequacy of:
   a. The product itself; i.e. compliance with the contract documents.
   b. Installation.
   c. Functional performance; include a brief description of the verification method used and observations and conclusions from the testing.
   d. O&M documentation, including design intent.
   e. Operator training.
6. List of all outstanding non-compliance items, referenced to the specific functional test, inspection, trend log, etc., where the deficiency is documented.
7. List of unresolved issues, seasonal or deferred testing, and other concerns that could affect facility operation.
8. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. (about four to six pages).
9. Attach appendices containing all commissioning documentation, including logs, minutes, reports, deficiency lists, communications, findings, etc., except that specified to be part of the Commissioning Record.


3.08 POST-OCCUPANCY PHASE

A. Assist in the development of a preventative maintenance plan, a detailed operating plan or an energy and resource management plan or as-built documentation.
B. Coordinate deferred and seasonal Functional Tests; verify correction of deficiencies.
C. On-Site Review: 10 months after Substantial Completion conduct on-site review with Owner's staff.
   1. Review the current facility operation and condition of outstanding issues related to the original and seasonal commissioning.
   2. Interview staff to identify problems or concerns they have operating the facility as originally intended.
   3. Make suggestions for improvements and for recording these changes in the O&M manuals.
   4. Identify areas of concern that are still under warranty or are the responsibility of the original construction contractor.
   5. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

END OF SECTION
SECTION 02 4100
DEMOLITION

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Selective demolition of built site elements.
   B. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS
   A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.
   B. Section 01 1000 - Summary: Sequencing and staging requirements.
   C. Section 01 1000 - Summary: Description of items to be removed by Owner.
   D. Section 01 1000 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
   E. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
   F. Section 01 5713 - Temporary Erosion and Sediment Control.
   G. Section 01 6000 - Product Requirements: Handling and storage of items removed for salvage and relocation.
   H. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
   I. Section 01 7419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
   J. Section 31 1000 - Site Clearing: Vegetation and existing debris removal.
   K. Section 31 2200 - Grading: Topsoil removal.
   L. Section 31 2200 - Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
   M. Section 31 2323 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Site Plan: Showing:
      1. Areas for temporary construction and field offices.
   C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 2 PRODUCTS
2.01 MATERIALS

PART 3 EXECUTION
3.01 SCOPE
   A. Remove portions of existing buildings in the following sequence:
1. Sawcut openings and prepare for new door systems in Existing Loading Dock 100, Upper Loading Dock 101 and Gallery 208 after full enclosure of the addition. Refer to drawings for details.

B. Remove paving and curbs as required to accomplish new work.

C. Remove manholes and manhole covers, curb inlets and catch basins.

D. Remove other items indicated, for salvage, relocation, and recycling.

**3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS**

A. Comply with other requirements specified in Section 01 7000.

B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Comply with applicable requirements of NFPA 241.
   3. Use of explosives is not permitted.
   4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   5. Provide, erect, and maintain temporary barriers and security devices.
   6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   8. Do not close or obstruct roadways or sidewalks without permit.
   9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
   10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

C. Do not begin removal until receipt of notification to proceed from Owner.

D. Do not begin removal until built elements to be salvaged or relocated have been removed.

E. Protect existing structures and other elements that are not to be removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB’s, and mercury.

H. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Comply with requirements of Section 01 7419 - Waste Management.
   2. Dismantle existing construction and separate materials.
   3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

I. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

**3.03 EXISTING UTILITIES**

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.
D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS
A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as shown.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
B. Separate areas in which demolition is being conducted from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000 in locations indicated on drawings.
C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
D. Remove existing work as indicated and as required to accomplish new work.
   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
   2. Remove items indicated on drawings.
E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   3. Verify that abandoned services serve only abandoned facilities before removal.
   4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
F. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch as specified for patching new work.

3.05 DEBRIS AND WASTE REMOVAL
A. Remove debris, junk, and trash from site.
B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 7419 - Waste Management.
C. Leave site in clean condition, ready for subsequent work.
D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION
SECTION 03 1119
INSULATING CONCRETE FORMS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Insulating concrete forms: Modular unit formwork system for cast-in-place concrete walls; formwork designed to remain in place after concrete work is complete.
B. Shoring, bracing and anchorage.
C. Openings for other work.
D. Accessories.

1.02 RELATED REQUIREMENTS
A. Section 03 1000 - Concrete Forming and Accessories: Conventional concrete forms designed to be removed after concrete is poured and related accessories.
B. Section 03 2000 - Concrete Reinforcing: Reinforcing steel to be placed at the same time as formwork specified in this section.
C. Section 03 3000 - Cast-in-Place Concrete: Concrete to be placed into formwork specified in this section.
D. Section 04 0201 - Masonry Veneer.
E. Section 05 4000 - Cold-Formed Metal Framing: Metal studs supporting insulating concrete forms for floors and roofs.

1.03 REFERENCE STANDARDS
A. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials (ACI 117-10) and Commentary; 2010.
B. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010 (Errata 2012).

1.04 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data form materials and installation requirements.
C. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.

1.06 QUALITY ASSURANCE
A. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Deliver insulating concrete form system units and accessories with manufacturer's printed installation instructions and in manufacturer's original packaging.
B. Protect insulating concrete form system units and accessories from exposure to sunlight.
C. Store insulating concrete form system units off ground in ventilated and protected manner to prevent damage and deterioration from moisture.

1.08 WARRANTY
A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS
B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FORMWORK - GENERAL
A. Provide insulating concrete forms, accessories, shoring, and bracing as required to accomplish insulated cast-in-place concrete work.
B. Design and construct to provide resultant concrete that conforms to design with respect to shape, lines, and dimensions.
C. Comply with applicable state and local codes with respect to design, fabrication and erection of formwork.

2.03 INSULATING CONCRETE FORMS
A. Performance Requirements:
   1. Thermal Insulance, R-value, of Assembled System: Calculated thermal insulance when tested in accordance with ASTM C177.
      a. Wall System: 22 deg F hr sq ft, minimum.
   2. Sound Transmission Class, Assembled Wall Units: 49, minimum; based on assembly composed of two rigid foam boards separated by an 8 inch concrete core with a metal panel exterior and 3/4 inch thick plywood interior.
B. Insulating Concrete Form Units for Walls: Rigid, expanded polystyrene boards; boards connected horizontally with injection--molded polypropylene webs and vertically by means of interlocking edges.
   1. Board Thickness: 2-1/2 inches.
   2. Web Spacing: 8 inches on center, horizontally.
   3. Web Configuration: 1/2 inch wide by 15 inches; integral supports for horizontal reinforcing steel; continuous end plates recessed 1/2 inch below surface of insulation on each face of unit to allow attachment of interior and exterior finishes without damage to insulation board.
   4. Concrete Core Thickness: 8 inches.
   5. Unit Types:
      a. Reversible straight form.
      b. Reversible 90 degree corner.
      c. Brick ledge.
      d. End cap.
2.04 COMPONENTS
   A. Expanded Polystyrene (EPS) Insulation Board, General: Comply with the minimum requirements of ASTM C578, Type II and the specified characteristics below.
      1. Density: 1.5 lb/cu ft when tested in accordance with ASTM D1622/D1622M.
      2. Compressive Strength: 15 psi when tested in accordance with ASTM D1621.
      3. Flexural Strength: 35 psi when tested in accordance with ASTM C203.
      4. Water Absorption: 3.0 percent by volume, maximum.
      5. Dimensional Stability: 2.0 percent, maximum, when tested in accordance with ASTM D2126.
      6. Oxygen Index: 24 percent by volume, minimum, when tested in accordance with ASTM D2863.
      7. Flammability; when tested in accordance with ASTM E84:
         a. Flame Spread: 25 or less.
         b. Smoke Developed: 450 or less.
   B. Accessories: Provide the manufacturer’s standard items listed below.
      1. Internal bracing and alignment.
      2. Door and window block outs.
      3. Sleeves for wall penetrations.

2.05 MATERIALS
   A. Concrete, for Use with insulating Concrete Forms: Comply with the applicable requirements of Section 03 3000 and specific requirements listed below.
      1. Aggregate:
         a. Normal weight.
         b. Size: 3/8 inch to 1/2 inch diameter.
      2. Compressive Strength: 3000 pounds per square inch, minimum.
      3. Water to Cement Ratio: 0.55 or less.
      4. Slump: 5 inches to 6 inches.
   B. Reinforcing Steel: Comply with the applicable requirements of Section 03 1000. Size, material grade, placement and spacing as shown on the structural drawings.
   C. Cold Formed Metal Framing: Comply with the applicable requirements of Section 05 4000. Size, material grade, placement and spacing as shown on the structural drawings.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify lines, levels and centers before proceeding with insulating concrete form work. Ensure that dimensions agree with drawings.
   B. Verify placement of dowels and other anchors in foundations comply with the approved contract documents and the recommendations of the insulating concrete form manufacturer.

3.02 PREPARATION
   A. Clean tops of footings and other foundation elements before starting formwork.

3.03 ERECTION - FORMWORK
   A. Erect formwork, shoring and bracing as recommended by the manufacturer. Protect forms from damage.
   B. Erect formwork, shoring and bracing to achieve design requirements. Comply with applicable requirements of ACI 301.
   C. Brace forms as recommended by manufacturer to ensure stability. Shore or strengthen formwork subject to overstressing by construction loads.
   D. Align joints. Install units in running bond.
   E. Ensure webs and attachment strips are properly aligned.
F. Install steel reinforcement as insulating concrete form work progresses and as shown on the structural engineering drawings.
G. Install alignment system as recommended by manufacturer and as work progresses.

3.04 INSERTS, EMBEDDED PARTS, AND OPENINGS
A. Remove insulating concrete form material and provide sleeves or other means to create formed openings where required. Cut forms for utility penetrations as needed. Coordinate location of openings for items to be embedded in or pass through concrete work.
B. Locate and set in place items that will be cast directly into concrete.
C. Install accessories in accordance with manufacturer’s instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

3.05 FORMWORK TOLERANCES
A. Construct formwork to maintain tolerances required by ACI 301 and ACI 117.

3.06 FIELD QUALITY CONTROL
A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
B. Inspect insulating concrete form system, shoring, and bracing to ensure that work complies with the approved shop drawings and to verify that supports, fastenings, webs, alignment devices, attachment strips and other items are secure.

3.07 CLEANING
A. Clean forms as installation progresses. Remove dirt, dust, debris, excess material, etc. within forms.
B. Clean formed cavities and openings.
C. Flush completed forms with compressed air or water.
   1. If water is used, ensure that water and debris drain to exterior through clean-out ports and that formwork is free of standing water and dry before concreting begins.
   2. During weather cold enough that water could be reasonably expected to freeze, do not use water to clean out forms unless form installation and concreting proceed within a heated enclosure.

END OF SECTION
PART 1  GENERAL

1.01  SECTION INCLUDES

A. Concrete formwork.
B. Concrete for composite floor construction.
C. Elevated concrete slabs.
D. Floors and slabs on grade.
E. Concrete shear walls, elevator shaft walls, foundation walls, and footings.
F. Concrete reinforcement.
G. Joint devices associated with concrete work.
H. Miscellaneous concrete elements, including equipment pads.
I. Concrete curing.

1.02  RELATED REQUIREMENTS

A. Section 03 3511 - Concrete Floor Finishes: Densifiers, hardeners, applied coatings, and polishing.
B. Section 07 9200 - Joint Sealants: Products and installation for sealants for saw cut joints and isolation joints in slabs.

1.03  REFERENCE STANDARDS

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; American Concrete Institute International; 2010.
B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2009).
C. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010 (Errata 2012).
D. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 2004 (Errata 2007).
E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
F. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.
G. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.
H. ACI 308R - Guide to Curing Concrete; American Concrete Institute International; 2001 (Reapproved 2008).
I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2011.
J. ACI 347R - Guide to Formwork for Concrete; American Concrete Institute International; 2014.
R. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.
V. ASTM D994/D994M - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type); 2011.
X. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011.
Y. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
C. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
   2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
D. Samples: Submit samples of underslab vapor retarder to be used.
E. Sustainable Design Submittal: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used; use LEED New Product Content Form.
F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE
A. Perform work of this section in accordance with ACI 301 and ACI 318.
   1. Maintain one copy of each document on site.
B. Follow recommendations of ACI 305R when concreting during hot weather.
C. Follow recommendations of ACI 306R when concreting during cold weather.

1.06 WARRANTY
A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Slabs with Moisture Vapor Reducing Admixture (MVRA): Provide warranty to cover the cost of flooring failures due to moisture migration from slabs for ten years.
   1. Include cost of repair or removal of failed flooring, placement of topical moisture remediation system, and replacement of flooring with comparable flooring system.
C. Moisture Emission Reducing Curing and Sealing Compound: Provide warranty to cost of flooring delamination failures for 10 years.
1. Include cost of repair or removal of failed flooring, remediation with a moisture vapor impermeable surface coating, and replacement of flooring with comparable flooring system.

PART 2 PRODUCTS

2.01 FORMWORK

A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.

B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
   1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
   2. Earth Cuts: Do not use earth cuts as forms for vertical surfaces. Natural rock formations that maintain a stable vertical edge may be used as side forms.
   3. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
   4. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.02 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
   1. Type: Deformed billet-steel bars.
   2. Finish: Unfinished, unless otherwise indicated.

B. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal; Type II - Moderate; Type III - High Early Strength. Portland type.
   1. Acquire all cement for entire project from same source.

   1. Acquire all aggregates for entire project from same source.

C. Fly Ash: ASTM C618, Class C or F.

D. Calcined Pozzolan: ASTM C618, Class N.

   1. Color(s): As selected by Architect from manufacturer's full range.

F. Water: Clean and not detrimental to concrete.

G. Fiber Reinforcement: ASTM C1116/C1116M.
   1. Fiber Type: Alkali-resistant synthetic.
   2. Fiber Length: 1" to 2 -1/4" inch, nominal.
   3. Products:

2.04 ADMIXTURES

A. Chemical Admixture Manufacturers:
3. Substitutions: See Section 01 6000 - Product Requirements.

B. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

C. Air Entrainment Admixture: ASTM C260/C260M.

D. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.

E. High Range Water Reducing Admixture: ASTM C494/C494M Type F.

F. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.

G. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.

H. Accelerating Admixture: ASTM C494/C494M Type C.

I. Retarding Admixture: ASTM C494/C494M Type B.

J. Water Reducing Admixture: ASTM C494/C494M Type A.

K. Shrinkage Reducing Admixture:
   1. ASTM C494/C494M, Type S.

L. Fiber Reinforcing Admixture:

2.05 ACCESSORY MATERIALS

A. Underslab Vapor Retarder: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
   1. Installation: Comply with ASTM E1643.
   2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations in vapor retarder.

B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. ASTM C1107/C1107M; Grade A, B, or C.
   2. Minimum Compressive Strength at 48 Hours, ASTM C109/C109M: 2,000 pounds per square inch.

2.06 BONDING AND JOINTING PRODUCTS

A. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.

B. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with minimum 1 inch diameter holes for conduit or rebars to pass through at 6 inches on center; ribbed steel stakes for setting.

2.07 CURING MATERIALS

A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
   1. Products:
      c. SpecChem, LLC; SpecFilm Concentrate or SpecFilm RTU: www.specchemllc.com.

   1. Product dissipates within 4 to 6 weeks.
   2. Provide product containing fugitive red dye.
   3. Products:

2.08 CONCRETE MIX DESIGN
A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
   1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
D. Fiber Reinforcement: Add to mix at rate of 1.5 pounds per cubic yard, or as recommended by manufacturer for specific project conditions.
E. Normal Weight Concrete:
   1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
   2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
   3. Cement Content: Minimum As required to reach the 28 day strength indicated. lb per cubic yard.
   4. Water-Cement Ratio: Maximum As indicated in Drawings percent by weight.
   5. Total Air Content: As indicated in Drawings percent, determined in accordance with ASTM C173/C173M.
   6. Maximum Slump: As indicated in Drawings inches.
   7. Maximum Aggregate Size: As indicated in Drawings inch.

2.09 MIXING
A. Transit Mixers: Comply with ASTM C94/C94M.
   1. Fiber Reinforcement: Batch and mix as recommended by manufacturer for specific project conditions.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION
A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
B. Verify that forms are clean and free of rust before applying release agent.
C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
D. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
   1. Granular Fill Over Vapor Retarder: Cover vapor retarder with compactible granular fill as shown on the drawings. Do not use sand.
   2. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as shown on the drawings. Do not use sand.
3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS
A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 PLACING CONCRETE
A. Place concrete in accordance with ACI 304R.
B. Place concrete for floor slabs in accordance with ACI 302.1R.
C. Notify Architect/Engineer/Special Inspector and Tester not less than 24 hours prior to commencement of placement operations.
D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.05 SLAB JOINTING
A. Locate joints as indicated on the drawings.
B. Anchor joint fillers and devices to prevent movement during concrete placement.
C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
D. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.
E. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.
F. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

3.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES
A. An independent testing agency, as specified in Section 01 4000, will inspect finished slabs for conformance to specified tolerances.
B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
   1. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15 At slab on grade and elevated slab not part of the collection storage.
   2. Collection Storage Slab in Grade and Elevated Slab: F(F) of 35; F(L) of 25.
C. Measure F(F) and F(L) in accordance with ASTM E1155, within 48 hours after slab installation; report both composite overall values and local values for each measured section.
D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.
E. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.07 CONCRETE FINISHING
A. Repair surface defects, including tie holes, immediately after removing formwork.
B. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
   1. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.

3.08 CURING AND PROTECTION
A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than 7 days.
   2. High early strength concrete: Not less than 4 days.
C. Surfaces Not in Contact with Forms:
   1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer’s satisfaction.
   2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
   3. Final Curing: Begin after initial curing but before surface is dry.

3.09 FIELD QUALITY CONTROL
A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
B. Provide free access to concrete operations at project site and cooperate with appointed firm.
C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
D. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure (4) four 6x12 or (5) five 4x8 concrete test cylinders. Obtain test samples for every 75 cubic yards or less of each class of concrete placed.
E. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
F. Test (2) 6x12 cylinders at 7 days and (2) 6x12 cylinders at 28 days for the compressive strength test, the average 28 day compressive strength will be considered as the strength. Test (2) 7 day 4x8 cylinders and (3) 4x8 at 28 days for the compressive strength test. The average of the (3) will be considered as the strength.
G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.
H. Perform on air test for each set of test cylinders taken following the procedures of ASTM C 231.

3.10 DEFECTIVE CONCRETE
A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.
3.11 PROTECTION
   A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION
SECTION 03 3511
CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface treatments for concrete floors and slabs.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with concrete floor placement and concrete floor curing.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.04 MOCK-UP

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.06 FIELD CONDITIONS

PART 2 PRODUCTS

2.01 CONCRETE FLOOR FINISH APPLICATIONS

A. Unless otherwise indicated, all concrete floors are to be finished using liquid densifier/hardener.

B. Liquid Densifier/Hardener:

1. Use at following locations: All new concrete floors.

C. High Gloss Clear Sealer:

1. Use at following locations: All new concrete floors.

2.02 DENSIFIERS AND HARDENERS

A. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set.

1. Composition: Lithium silicate.

2. Products:
   e. Substitutions: See Section 01 6000 - Product Requirements.

2.03 COATINGS

A. High Gloss Clear Sealer: Transparent, non-yellowing, water-based coating.


2. Nonvolatile Content: 40 percent, minimum, when measured by volume.

3. Products:
   e. The QUIKRETE Companies; QUIKRETE® Concrete & Masonry High Gloss Sealer: www.quikrete.com.
   g. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.
B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 GENERAL
A. Apply materials in accordance with manufacturer's instructions.

3.03 COATING APPLICATION
A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.
C. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
D. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

END OF SECTION
SECTION 04 2001
MASONRY VENEER

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Clay Facing Brick.
B. Mortar.
C. Reinforcement and Anchorage.
D. Flashings.
E. Installation of Lintels.
F. Accessories.

1.02 RELATED REQUIREMENTS
A. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS
A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; American Concrete Institute International; 2011.
H. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2014.
L. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and cavity drainage system.
C. Samples: Submit four samples of facing brick units to illustrate color, texture, and extremes of color range.
D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
1.06 QUALITY ASSURANCE
   A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the contract documents.

1.07 MOCK-UP
   A. Construct a masonry wall as a mock-up panel sized 8 feet long by 6 feet high; include mortar and accessories in mock-up.
   B. Locate where directed.
   C. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING
   A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

1.09 FIELD CONDITIONS
   A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.
   B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.01 BRICK UNITS
   A. Facing Brick: ASTM C216, Type FBS, Grade SW.
      2. Nominal Size: Match existing.

2.02 MORTAR MATERIALS
   A. Masonry Cement: ASTM C91/C91M Type N.
   B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
   C. Hydrated Lime: ASTM C207, Type S.
   D. Water: Clean and potable.
   E. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.

2.03 REINFORCEMENT AND ANCHORAGE
   A. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi) yield strength, deformed billet bars; galvanized.
   B. Joint Reinforcement: Truss type; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
      1. Manufacturers:
         b. Substitutions: See Section 01 6000 - Product Requirements.
   C. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
      1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
      2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
      3. Vertical adjustment: Not less than 3-1/2 inches.
4. Seismic Feature: Provide lip, hook, or clip on end of wire ties to engage or enclose not less than one continuous horizontal joint reinforcement wire of 0.1483 inch diameter.

2.04 FLASHINGS
A. Flexible Flashing with Elvaloy KEE: Solid-phase flexibilizer added to membrane flashing.
B. EPDM Flashing: ASTM D4637/D4637, Type I, 0.040 inch thick.
C. Factory-Fabricated Flashing Corners and Ends: PVC with Elvaloy KEE.
D. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane, or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.

2.05 ACCESSORIES
A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
B. Weeps: Open head joint every 24 inches.
C. Drainage Fabric: Polyester mesh.
D. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
E. Drip Edge: Polyvinyl chloride (PVC); compatible with membrane and adhesives.
F. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.
G. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.06 MORTAR MIXES
   1. Exterior, non-loadbearing masonry; Type N.
B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
C. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that field conditions are acceptable and are ready to receive masonry.
B. Verify that related items provided under other sections are properly sized and located.
C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 COURSING
A. Establish lines, levels, and coursing indicated. Protect from displacement.
B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
C. Brick Units:
   1. Bond: Match existing pattern on Museum of the Rockies.
   2. Coursing: Three units and three mortar joints to equal 8 inches.

3.03 PLACING AND BONDING
A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
C. Remove excess mortar as work progresses.
D. Interlock intersections and external corners.
E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.04 WEEPS/CAVITY VENTS
A. Install weeps in veneer walls at 24 inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.

3.05 CAVITY MORTAR CONTROL
A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
C. Install cavity mortar control panels continuously throughout full height of exterior masonry cavities during construction of exterior wythe, complying with manufacturer's installation instructions. Verify that airspace width is no more than 3/8 inch greater than panel thickness. Install horizontally between joint reinforcement. Stagger end joints in adjacent rows. Fit to perimeter construction and penetrations without voids.
D. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.06 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER
A. Install horizontal joint reinforcement 16 inches on center.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
C. Place continuous joint reinforcement in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6 inches.
E. Insulated Concrete Form (ICF) Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 36 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
F. Seismic Reinforcement: Connect veneer anchors with continuous horizontal wire reinforcement before embedding anchors in mortar.

3.07 MASONRY FLASHINGS
A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
   1. Extend flashings full width at such interruptions and at least 6 inches into adjacent masonry or turn up at least 8 inches to form watertight pan at non-masonry construction.
   2. Remove or cover protrusions or sharp edges that could puncture flashings.
   3. Seal lapped ends and penetrations of flashing before covering with mortar.
B. Extend EPDM flashings to within 1/4 inch of exterior face of masonry.
C. Lap end joints of flashings at least 6 inches and seal watertight with flashing sealant/adhesive.

3.08 LINTELS
A. Install loose steel lintels over openings.

3.09 CONTROL AND EXPANSION JOINTS
A. Do not continue horizontal joint reinforcement through control or expansion joints.
B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
C. Size control joints as indicated on drawings; if not shown, 3/4 inch wide and deep.
D. Form expansion joint as detailed on drawings.

3.10 TOLERANCES
   A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
   B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
   C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
   D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
   E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

3.11 CUTTING AND FITTING
   A. Cut and fit for pipes and conduit. Coordinate with other sections of work to provide correct size, shape, and location.
   B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 CLEANING
   A. Remove excess mortar and mortar smears as work progresses.
   B. Replace defective mortar. Match adjacent work.
   C. Clean soiled surfaces with cleaning solution.
   D. Use non-metallic tools in cleaning operations.

3.13 PROTECTION
   A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION
SECTION 05 1200
STRUCTURAL STEEL

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Structural steel framing members, support members and struts.
   B. Base plates, shear stud connectors and expansion joint plates.
   C. Grouting under base plates.

1.02 RELATED REQUIREMENTS
   A. Section 05 2100 - Steel Joist Framing.
   B. Section 05 3100 - Steel Decking: Support framing for small openings in deck.
   C. Section 05 5000 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.03 REFERENCE STANDARDS
   H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
V. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2012.
Y. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2009.
Z. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; Society for Protective Coatings; 1999 (Ed. 2004).

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings:
   1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
   2. Connections not detailed.
   3. Indicate cambers and loads.
   4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
D. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
E. Fabricator Test Reports: Comply with ASTM A1011/A1011M.
F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE
A. Fabricate structural steel members in accordance with AISC "Steel Construction Manual."
B. Maintain one copy of each document on site.
C. Fabricator: Company specializing in performing the work of this section with minimum (5) Five years of documented experience.
D. Erector: Company specializing in performing the work of this section with minimum (5) Five years of documented experience.

PART 2 PRODUCTS
2.01 MATERIALS
A. Steel Angles and Plates: ASTM A36/A36M.
B. Steel W Shapes and Tees: ASTM A992/A992M.
C. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.
E. Shear Stud Connectors: Made from ASTM A 108 Grade 1015 bars.
F. High-Strength Structural Bolts, Nuts, and Washers: ASTM A325 or ASTM A325M, Type 1, medium carbon, galvanized, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436 washers.

G. Tension Control Bolts: Twist-off type; ASTM F1852 or ASTM F2280.

H. Headed Anchor Rods: ASTM F1554, Grade 36, ASTM F1554, Grade 55 plain.

I. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

J. Grout: Non-shrink, non-metallic aggregate type, complying with ASTM C1107/C1107M and capable of developing a minimum compressive strength of 7,000 psi at 28 days.

K. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

L. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Shop fabricate to greatest extent possible.

B. Space shear stud connectors at As indicated on Drawings. inches on center.

2.03 FINISH

A. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.

B. Galvanize structural steel members to comply with ASTM A123/A123M. Provide minimum 1.7 oz/sq ft galvanized coating.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

A. Erect structural steel in compliance with AISC "Code of Standard Practice for Steel Buildings and Bridges".

B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Field weld components and shear studs indicated on shop drawings.

D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts".

E. Do not field cut or alter structural members without approval of Engineer.

F. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts", testing at least 100 percent of bolts at each connection.

C. Welded Connections: Visually inspect all field-welded connections.

END OF SECTION
SECTION 05 2100
STEEL JOIST FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Open web steel joists and shear stud connectors, with bridging, attached seats and anchors.
   B. Supplementary framing for floor and roof openings greater than 18 inches.

1.02 RELATED REQUIREMENTS
   A. Section 05 1200 - Structural Steel: Grouting base plates and bearing plates. Superstructure framing.
   B. Section 05 1200 - Structural Steel: Superstructure framing.
   C. Section 05 3100 - Steel Decking: Bearing plates and angles.
   D. Section 05 3100 - Steel Decking: Support framing for openings less than 18 inches in decking.
   E. Section 05 5000 - Metal Fabrications: Non-framing steel fabrications attached to joists.

1.03 REFERENCE STANDARDS
   G. SJI (SPEC) - Catalog of Standard Specifications and Load Tables for Steel Joists and Joist Girders; Steel Joist Institute; 2011.
   H. SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders; Steel Joist Institute; 2008.

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments.
   C. Welders’ Certificates: Submit manufacturer’s certificates, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.
   D. Manufacturer’s Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE
   A. Perform Work, including that for headers and other supplementary framing, in accordance with SJI Standard Specifications Load Tables and SJI Technical Digest No.9.
   B. Manufacturer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.
   C. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel (AC172).
   D. Erector Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.
1.06 DELIVERY, STORAGE, AND HANDLING
   A. Transport, handle, store, and protect products to SJI requirements.

PART 2 PRODUCTS
2.01 MANUFACTURERS
   A. Steel Joists:
      1. Canam Group Inc:  www.canam-steeljoists.ws
      3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS
   A. Open Web Joists: SJI Type K Joists:
      1. Provide bottom chord extensions as indicated.
      2. Minimum End Bearing on Steel Supports: Comply with referenced SJI standard.
      3. Minimum End Bearing on Concrete or Masonry Supports: Comply with referenced SJI standard.
      4. Finish: Shop primed.
   C. High-Strength Structural Bolts, Nuts, and Washers: ASTM A325 or ASTM A325M, Type 1, medium carbon, galvanized, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436 washers.
   D. High-Strength Structural Bolts: ASTM A490 or ASTM A490M; Type 1 alloy steel, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436 washers.
   E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

2.03 FABRICATION
   A. Frame special sized openings in joist web framing as detailed.

2.04 FINISH
   A. Shop prime joists as specified.
      1. Do not prime surfaces that will be fireproofed.
      2. Galvanize steel ledger angles.
      3. Leave other steel members unprimed.
   B. Prepare surfaces to be finished in accordance with SSPC-SP 2.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify existing conditions prior to beginning work.

3.02 ERECTION
   A. Erect joists with correct bearing on supports.
   B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.
   C. Coordinate the placement of anchors for securing loose bearing members furnished as part of the work of this section.
   D. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.
   E. Install supplementary framing for floor and roof openings greater than 18 inches.
   F. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.
   G. Do not field cut or alter structural members without approval of joist manufacturer.
H. After erection, prime welds, damaged shop primer, damaged galvanizing, and surfaces not shop primed, except surfaces specified not to be primed.

3.03 TOLERANCES
   A. Maximum Variation From Plumb: 1/4 inch.
   B. Maximum Offset From True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL
   A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
   B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts", testing at least 100 percent of bolts at each connection.
   C. Welded Connections: Visually inspect all field-welded connections.

END OF SECTION
SECTION 05 3100
STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Roof deck.
B. Composite floor deck.
C. Bearing plates and angles.
D. Stud shear connectors.

1.02 RELATED REQUIREMENTS
A. Section 03 3000 - Cast-in-Place Concrete: Concrete topping over metal deck.
B. Section 04 2000 - Unit Masonry: Placement of anchors for bearing plates embedded in unit masonry assemblies.
C. Section 05 1200 - Structural Steel: Support framing for openings larger than 18 inches and shear stud connectors.
D. Section 05 1200 - Structural Steel: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.
E. Section 05 2100 - Steel Joist Framing: Support framing for openings larger than 18 inches.
F. Section 05 5000 - Metal Fabrications: Steel angle concrete stops at deck edges.

1.03 REFERENCE STANDARDS
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
G. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; Factory Mutual System; 2006.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
D. Certificates: Certify that products furnished meet or exceed specified requirements.
E. Submit manufacturer's installation instructions.
F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

G. Fabricator’s Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Cut plastic wrap to encourage ventilation.
B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Deck:
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 STEEL DECK

A. Roof Deck: Non-composite type, fluted steel sheet:
      a. Grade as required to meet performance criteria.
   2. Structural Properties: As indicated in Drawings.
   3. Minimum Base Metal Thickness: As indicated in drawings.
   4. Nominal Height: As indicated in Drawings
   5. Profile: Fluted; SDI NR.
   6. Formed Sheet Width: 36 inch.
   7. Side Joints: Lock seam.

B. Composite Floor Deck: Fluted steel sheet embossed to interlock with concrete:
   2. Structural Properties: As indicated in Drawings.
   5. Nominal Height: 1-1/2 inches.
   6. Profile: Fluted; SDI NR.
   7. Formed Sheet Width: 24 inch.

2.03 ACCESSORY MATERIALS

A. Bearing Plates and Angles: ASTM A36/A36M steel, galvanized per ASTM A123/A123M.
B. Stud Shear Connectors: Made from ASTM A108 Grade 1015 bars.
C. Welding Materials: AWS D1.1/D1.1M.
D. Fasteners: Galvanized hardened steel, self tapping.
E. Powder Actuated Mechanical Fasteners: Steel; with knurled shank and forged ballistic point. Comply with applicable requirements of ICC-ES AC70.
   1. Design Requirements: Provide number and type of fasteners that comply with the applicable requirements of SDI design method for roof deck and floor deck applications and ICC-ES AC43.
F. Mechanical Fasteners: Steel; hex washer head, self-drilling, self-tapping.
1. Design Requirements for Sidelap Connections: Provide number and type of fasteners that comply with the applicable requirements of SDI design method for roof deck and floor deck applications and ICC-ES AC43.

2. Fasteners for Steel Roof Decks Protected with Waterproofing Membrane: ASTM B 633, SC1, Type III zinc electroplate.

3. Fasteners for Exposed Steel Roof Deck Application: Manufacturer's standard stainless steel with bonded neoprene washer.

4. Products:

G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

H. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

2.04 FABRICATED DECK ACCESSORIES

A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gage, 0.0299 inch thick sheet steel; of profile and size as indicated; finished same as deck.

B. Cant Strips: Formed sheet steel, ___ gage, ___ inch minimum thickness, 45 degree slope, 3-1/2 inch nominal width and height, flange for attachment.

C. Roof Sump Pans: Formed sheet steel, 14 gage, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.

B. On concrete and masonry surfaces provide minimum 4 inch bearing.

C. On steel supports provide minimum 1-1/2 inch bearing.

D. Fasten deck to steel support members at ends and intermediate supports as indicated in Drawings

E. Drive mechanical sidelp connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.

F. Weld deck in accordance with AWS D1.3/D1.3M.

G. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.

H. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.

I. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.

J. Weld stud shear connectors through steel deck to structural members below.

K. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

END OF SECTION
**SECTION 05 4000**  
COLD-FORMED METAL FRAMING

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

A. Formed steel stud interior wall framing.

B. Exterior wall sheathing.

**1.02 RELATED REQUIREMENTS**

A. Section 06 1000 - Rough Carpentry: Wood blocking and miscellaneous framing.

B. Section 07 9200 - Joint Sealants.

C. Section 09 2116 - Gypsum Board Assemblies: Lightweight, non-load bearing metal stud framing.

**1.03 REFERENCE STANDARDS**

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.


C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.


E. ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases; 2011c.


**1.04 ADMINISTRATIVE REQUIREMENTS**

A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

**1.05 SUBMITTALS**

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention.

**1.06 QUALITY ASSURANCE**

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.
PART 2 PRODUCTS

2.01 FRAMING SYSTEM
A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

2.02 FRAMING MATERIALS
A. Studs and Track: ASTM C955; studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.
   1. Gage and Depth: As indicated on the drawings.
   2. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.
   3. Provide components fabricated from ASTM A1008/A1008M, Designation SS (structural steel).
B. Framing Connectors: Factory-made, formed steel sheet.
   1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gage, 0.1345 inch, and factory punched holes and slots.
   2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
      a. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1 inch.

2.03 WALL SHEATHING
A. Wall Sheathing: Gypsum; complying with requirements of ASTM C1396/C1396M for gypsum sheathing, V-shaped long edges, 5/8 inch Type X fire resistant.

2.04 ACCESSORIES
A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.05 FASTENERS
A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
B. Anchorage Devices: Powder actuated.
C. Welding: In conformance with AWS D1.1/D1.1M.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that substrate surfaces are ready to receive work.
B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION OF STUDS
A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.
B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 16 inches on center.
3. 

C. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.

D. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

E. Install intermediate studs above and below openings to align with wall stud spacing.

F. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.

G. Attach cross studs to studs for attachment of fixtures anchored to walls.

H. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

I. Touch-up field welds and damaged galvanized surfaces with primer.

3.03 WALL SHEATHING

A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel items.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
B. Section 04 2001 - Masonry Veneer: Placement of metal fabrications in masonry.
C. Section 05 1200 - Structural Steel: Structural steel column anchor bolts.
D. Section 05 2100 - Steel Joist Framing: Structural joist bearing plates, including anchorage.
E. Section 05 3100 - Steel Decking: Bearing plates for metal deck bearing, including anchorage.
F. Section 05 5100 - Metal Stairs.
G. Section 05 5213 - Pipe and Tube Railings.

1.03 REFERENCE STANDARDS

E. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric); 2014.
F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
H. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2012.
K. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; Society for Protective Coatings; 1999 (Ed. 2004).
L. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
C. Welders’ Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
D. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.
PART 2 PRODUCTS

2.01 MATERIALS - STEEL
   A. Steel Sections: ASTM A36/A36M.
   B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
   C. Plates: ASTM A283.
   E. Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, plain.
   F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
   G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION
   A. Fit and shop assemble items in largest practical sections, for delivery to site.
   B. Fabricate items with joints tightly fitted and secured.
   C. 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. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS
   A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
      1. Side Rails: 3/8 x 2 inches members spaced at 20 inches.
      2. Rungs: one inch diameter solid round bar spaced 12 inches on center.
      3. Space rungs 7 inches from wall surface.
   B. Bumper Posts and Guard Rails: As detailed; prime paint finish.
   C. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
   D. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.
   E. Lintels: As detailed; prime paint finish.

2.04 FINISHES - STEEL
   A. Prime paint steel items.
   B. Prepare surfaces to be primed in accordance with SSPC-SP2.
   C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
   D. Prime Painting: One coat.

2.05 FABRICATION TOLERANCES
   A. Squareness: 1/8 inch maximum difference in diagonal measurements.
   B. Maximum Offset Between Faces: 1/16 inch.
   C. Maximum Misalignment of Adjacent Members: 1/16 inch.
   D. Maximum Bow: 1/8 inch in 48 inches.
   E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that field conditions are acceptable and are ready to receive work.
3.02 PREPARATION
   A. Clean and strip primed steel items to bare metal where site welding is required.
   B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION
   A. Install items plumb and level, accurately fitted, free from distortion or defects.
   B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
   C. Field weld components as indicated on drawings.
   D. Perform field welding in accordance with AWS D1.1/D1.1M.
   E. Obtain approval prior to site cutting or making adjustments not scheduled.
   F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.04 TOLERANCES
   A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
   B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stairs with concrete treads.
B. Stairs with grating treads.
C. Structural steel stair framing and supports.
D. Handrails and guards.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete fill in stair pans; mesh reinforcement for landings.
B. Section 03 3000 - Cast-in-Place Concrete: Placement of metal anchors in concrete.
C. Section 04 2000 - Unit Masonry: Placement of metal fabrications in masonry.
D. Section 05 5000 - Metal Fabrications.
E. Section 05 5213 - Pipe and Tube Railings: Metal handrails and balusters other than specified in this section.

1.03 REFERENCE STANDARDS

G. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric); 2014.
H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
L. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2012.
O. NAAMM MBG 531 - Metal Bar Grating Manual; The National Association of Architectural Metal Manufacturers; 2009.


Q. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; The Society for Protective Coatings; 1999 (Ed. 2004).


S. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Include the design engineer’s stamp or seal on each sheet of shop drawings.

C. Delegated Design Data: As required by authorities having jurisdiction.

D. Welders' Certificates.

E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 201.

F. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE
A. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.

B. Fabricator Qualifications:
   1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
   2. A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel (AC172).
   3. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

PART 2 PRODUCTS
2.01 METAL STAIRS - GENERAL
A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
   1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, state, and federal regulations; where requirements of the contract documents exceed those of regulations, comply with the contract documents.
   2. At exit stairwells, provide unit stair towers designed for stacking to height of building as a self-supporting structure.
   3. Dimensions: As indicated on drawings.
   4. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
   5. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
   6. Separate dissimilar metals using paint or permanent tape.

B. Metal Jointing and Finish Quality Levels:
   1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
      a. Welded Joints: Continuously welded and ground smooth and flush.
b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
c. Exposed Edges and Corners: Eased to small uniform radius.
d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality
gloss finish.

2. Industrial: All joints made neatly.
a. Welded Joints: Welded on back side wherever possible.
b. Welds Exposed to Touch: Ground smooth.
c. Bolts Exposed to Touch in Travel Area: No nuts or screw threads exposed to touch.

C. Fasteners: Same material or compatible with materials being fastened; type consistent with
design and specified quality level.

D. Anchors and Related Components: Same material and finish as item to be anchored, except
where specifically indicated otherwise; provide all anchors and fasteners required.

2.02 METAL STAIRS WITH CONCRETE TREADS

A. Jointing and Finish Quality Level: Architectural, as defined above.

B. Risers: Closed.

C. Treads: Metal pan with field-installed concrete fill.
1. Concrete Depth: 1-1/2 inches, minimum.
2. Tread Pan Material: Steel sheet.
3. Tread Pan Thickness: As required by design; 14 gage, 0.075 inch minimum.
4. Concrete Reinforcement: None.
5. Concrete Finish: For resilient floor covering.

D. Risers: Same material and thickness as tread pans.
1. Nosing Depth: Not more than 1-1/2 inch overhang.
2. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.

E. Stringers: Rolled steel channels.
1. Stringer Depth: As indicated on drawings.
2. End Closure: Sheet steel of same thickness as risers welded across ends.

F. Landings: Similar construction, using corrugated steel decking, supported and reinforced as
required to achieve design load capacity.

G. Railings: Steel pipe railings.

H. Finish: Shop- or factory-prime painted.

I. Under Side of Stair: Exposed to view, to be finished same as specified for other exposed to
view surfaces.

2.03 METAL STAIRS WITH GRATING TREADS

A. Jointing and Finish Quality Level: Industrial, as defined above.

B. Risers: Open.

C. Treads: Steel bar grating.
1. Grating Type: Welded.
2. Bearing Bar Depth: 3/4 inch, minimum.
3. Top Surface: Standard.
6. Anchorage to Stringers: End plates welded to grating, bolted to stringers.

D. Stringers: Rolled steel channels.
1. Stringer Depth: 10 inches.
2. End Closure: Sheet steel of same thickness as risers welded across ends.

E. Railings: Steel pipe railings.

F. Finish: Galvanized after fabrication.
G. Location: Collections Storage 204 and Loading Dock 100

2.04 HANDRAILS AND GUARDS
A. Wall-Mounted Rails: Round pipe or tube rails unless otherwise indicated.
   1. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.
B. Guards:
   1. Top Rails: Round pipe or tube rails unless otherwise indicated.
      a. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.
   2. Infill at Pipe Railings: Pipe or tube rails sloped parallel to stair.
      b. Material: Steel pipe or tube, round.
      c. Vertical Spacing: Maximum 4 inches on center.
      d. Jointing: Welded and ground smooth and flush.
   3. End and Intermediate Posts: Same material and size as top rails.
      a. Horizontal Spacing: As indicated on drawings.
      b. Mounting: Welded to top surface of stringer.

2.05 MATERIALS
A. Steel Sections: ASTM A36/A36M.
B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.
C. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
D. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
   1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
   2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).
E. Gratings: Bar gratings complying with NAAMM MBG 531 or NAAMM MBG 532, whichever applies based on bar sizes.
F. Concrete Fill: Portland cement Type I, 3000 psi 28 day strength, 2 to 3 inch slump.

2.06 ACCESSORIES
A. Steel Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
B. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
C. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.07 SHOP FINISHING
A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
B. Do not prime surfaces in direct contact with concrete or where field welding is required.
C. Prime Painting: Use specified shop- and touch-up primer.
   1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning.
   2. Number of Coats: One.
D. Galvanizing: Hot-dip galvanize to minimum requirements of ASTM A123/A123M.
   1. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that field conditions are acceptable and are ready to receive work.
3.02 PREPARATION
   A. When field welding is required, clean and strip primed steel items to bare metal.
   B. Supply items required to be cast into concrete and embedded in masonry with setting templates.

3.03 INSTALLATION
   A. Install components plumb and level, accurately fitted, free from distortion or defects.
   B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
   C. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
   D. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
   E. Obtain approval prior to site cutting or creating adjustments not scheduled.
   F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 SCHEDULES
   A. Stairs 108/203: Concrete-filled pan treads and landings, primed finish, field paint.
   B. Loading Dock 100 stairs/landing: Metal grating, galvanized.
   C. Mezzanine (Collections 204) stairs: Metal grating, galvanized.

END OF SECTION
PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Wall mounted handrails.
   B. Stair railings and guardrails.
   C. Free-standing railings at steps.
   D. Balcony railings and guardrails.

1.02 RELATED REQUIREMENTS
   A. Section 03 3000 - Cast-in-Place Concrete: Placement of anchors in concrete.
   B. Section 05 5100 - Metal Stairs: Handrails other than those specified in this section.
   C. Section 05 5100 - Metal Stairs: Attachment plates for handrails specified in this section.
   D. Section 09 2116 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

1.03 REFERENCE STANDARDS
   D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
   G. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; Society for Protective Coatings; 1999 (Ed. 2004).

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

PART 2 PRODUCTS
2.01 RAILINGS - GENERAL REQUIREMENTS
   A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.
   B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.
   C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.
D. Allow for expansion and contraction of members and building movement without damage to connections or members.

E. Dimensions: See drawings for configurations and heights.
   1. Top Rails and Wall Rails: 1-1/2 inches diameter, round.

F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
   1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
   2. For anchorage to stud walls, provide backing plates, for bolting anchors.

G. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 STEEL RAILING SYSTEM

A. Steel Tube: ASTM A500/A500M, Grade B cold-formed structural tubing.

B. Steel Pipe: ASTM A53/A53M, Grade B Schedule 80, galvanized finish.

C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

D. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

E. Galvanizing: In accordance with requirements of ASTM A123/A123M.
   1. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type II - Organic.

F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:
   1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
   2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
   3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

C. Apply one coat of bituminous paint to concealed aluminum surfaces that will be in contact with cementitious or dissimilar materials.
3.03 INSTALLATION
   A. Install in accordance with manufacturer's instructions.
   B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
   C. Install railings in compliance with ADA Standards for accessible design at applicable locations.
   D. Anchor railings securely to structure.
   E. Field weld anchors as indicated on drawings. Touch-up welds with primer. Grind welds smooth.
   F. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.04 TOLERANCES
   A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
   B. Maximum Offset From True Alignment: 1/4 inch.

3.05 SCHEDULE
   A. Finishes:
      1. Stairs 108/203: Primed finish, field paint. Refer to Division 05 5100.
      2. Loading Dock 100 stairs: Galvanized.
      3. Mezzanine (at Collections 204) stair, handrails and guardrail: Galvanized

END OF SECTION
SECTION 05 5305
GRATINGS AND FLOOR PLATES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Formed metal mezzanine and stair tread gratings.
B. Flat surface floor and stair tread plating.

1.02 RELATED REQUIREMENTS
A. Section 05 5000 - Metal Fabrications.
B. Section 05 5100 - Metal Stairs: Framing for grating and stair treads.
C. Section 07 9513 - Expansion Joint Cover Assemblies.

1.03 REFERENCE STANDARDS
E. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric); 2012e1.
F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2012.
H. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; Society for Protective Coatings; 1999 (Ed. 2004).
J. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide span and deflection tables.
C. Shop Drawings: Indicate details of component supports, openings, perimeter construction details, and tolerances.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
D. Welders’ Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

PART 2 PRODUCTS

2.01 MATERIALS
A. Steel For Welding or Riveting: ASTM A36/A36M, unfinished, of shapes indicated.
B. Steel Framing: ASTM A36/A36M shapes, unfinished.
C. Cross Bars: ASTM B211 (ASTM B211M) solid bars.
D. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
E. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
F. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 ACCESSORIES
A. Fasteners and Saddle Clips: Galvanized steel.

2.03 FABRICATION
A. Fabricate grates and plates to accommodate design loads.
B. Fabricate support framing for openings.
C. Bearing Bar: As indicated on Drawings.
D. Cross Bar: As indicated on Drawings.

2.04 FINISHES
A. Prepare surfaces to be primed in accordance with SSPC-SP 2.
B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
C. Do not prime surfaces in direct contact with concrete or where field welding is required.
D. Prime paint items with one coat.
E. Galvanizing for Steel Shapes: ASTM A123/A123M.
F. Galvanizing for Steel Hardware: ASTM A153/A153M.
G. Non-Slip Surfacing: Aluminum oxide.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that field measurements are as indicated on drawings.
B. Verify that opening sizes and dimensional tolerances are acceptable.
C. Verify that supports are correctly positioned.

3.02 INSTALLATION
A. Install components in accordance with manufacturer's instructions.
B. Place frames in correct position, plumb and level.
C. Mechanically cut galvanized finish surfaces. Do not flame cut.
D. Anchor by welding.
E. Set perimeter closure flush with top of grating and surrounding construction.
F. Secure to prevent movement.

END OF SECTION
SECTION 06 1000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Roof-mounted curbs.
B. Roofing nailers.
C. Miscellaneous framing and sheathing.
D. Communications and electrical room mounting boards.
E. Concealed wood blocking, nailers, and supports.
F. Miscellaneous wood nailers, furring, and grounds.

1.02 REFERENCE STANDARDS
C. PS 1 - Structural Plywood; 2009.
E. WWPA G-5 - Western Lumber Grading Rules; Western Wood Products Association; 2011.

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.04 DELIVERY, STORAGE, AND HANDLING
A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

1.05 WARRANTY
A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS
A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
   2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
B. Lumber fabricated from old growth timber is not permitted.
C. Provide sustainably harvested wood; see Section 01 6000 - Product Requirements for requirements.
D. Lumber salvaged from deconstruction or demolition of existing buildings or structures is permitted in lieu of sustainably harvested lumber provided it is clean, denailed, and free of paint and finish materials, and other contamination; identify source.
E. Lumber fabricated from recovered timber (abandoned in transit) is permitted in lieu of sustainably harvested lumber, unless otherwise noted, provided it meets the specified requirements for new lumber and is free of contamination; identify source.
2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS
A. Grading Agency: Western Wood Products Association (WWPA).
B. Sizes: Nominal sizes as indicated on drawings, S4S.
C. Moisture Content: S-dry or MC19.
D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS
A. Wall Sheathing for Collections Storage.
   2. Grade: C-D.
   4. Performance Category: 3/4 PERF CAT.
   5. Edge Profile: Square edge.
B. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.04 ACCESSORIES
A. Fasteners and Anchors:

PART 3 EXECUTION
3.01 PREPARATION
A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL
A. Select material sizes to minimize waste.
B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.03 BLOCKING, NAILERS, AND SUPPORTS
A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
F. Provide the following specific non-structural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.
   4. Wall-mounted door stops.
5. Chalkboards and marker boards.
6. Wall paneling and trim.
7. Joints of rigid wall coverings that occur between studs.

3.04 ROOF-RELATED CARPENTRY
A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
B. Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

3.05 INSTALLATION OF CONSTRUCTION PANELS
A. Wall Sheathing: Secure with long dimension perpendicular to insulated concrete form ties, with ends over firm bearing and staggered, using nails, screws, or staples.
   1. Maintain 1/4" clearance between concrete floor first row of plywood wall sheathing.
B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
   1. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   2. Install adjacent boards without gaps.
   3. Size and Location: As indicated on drawings.

3.06 TOLERANCES
A. Framing Members: 1/4 inch from true position, maximum.
B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.07 CLEANING
A. Waste Disposal: Comply with the requirements of Section 01 7419 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.
B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION
SECTION 06 4100
ARCHITECTURAL WOOD CASEWORK

PART 1  GENERAL
1.01  SECTION INCLUDES
   A. Specially fabricated cabinet units.
   B. Countertops.
   C. Cabinet hardware.
   D. Factory finishing.
   E. Preparation for installing utilities.

1.02  RELATED REQUIREMENTS
   A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

1.03  REFERENCE STANDARDS
   A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
   B. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.9).
   C. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.

1.04  ADMINISTRATIVE REQUIREMENTS
   A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05  SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
      1. Minimum Scale of Detail Drawings: 1-1/2 inch to 1 foot.
   C. Product Data: Provide data for hardware accessories.
   D. Samples: Submit actual samples of architectural cabinet construction, minimum 8 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.
   E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.06  QUALITY ASSURANCE
   A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.07  DELIVERY, STORAGE, AND HANDLING
   A. Protect units from moisture damage.

1.08  FIELD CONDITIONS
   A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2  PRODUCTS
2.01  CABINETS
   A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI (AWS) for Custom Grade.
   B. Plastic Laminate Faced Cabinets: Custom grade.
   C. Cabinets at Secure Storage:
2. Finish - Exposed Interior Surfaces: Decorative laminate.
3. Finish - Concealed Surfaces: Manufacturer's option.
4. Door and Drawer Front Edge Profiles: Square edge with thick applied band.
5. Casework Construction Type: Type A - Frameless.
6. Interface Style for Cabinet and Door: Style 1 - Overlay; flush overlay.
7. Grained Face Layout for Cabinet and Door Fronts: Flush panel.

### 2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.
B. Provide wood harvested within a 500 mile radius of the project site.
C. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless otherwise noted, provided it is clean and free of contamination; identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc.

### 2.03 LAMINATE MATERIALS

A. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
B. Provide specific types as scheduled.
   1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, color as selected, satin finish.
   2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, color as selected, satin finish.

### 2.04 COUNTERTOPS

A. Plastic Laminate Countertops: Medium density fiberboard substrate covered with HPDL, conventionally fabricated and self-edge banded.

### 2.05 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.
B. Plastic Edge Banding: Extruded PVC, flat shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
   1. Color: As selected by Architect from manufacturer's standard range.
   2. Use at countertop edge.
C. Fasteners: Size and type to suit application.
D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
E. Concealed Joint Fasteners: Threaded steel.

### 2.06 HARDWARE

A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, satin chrome finish, for nominal 1 inch spacing adjustments.
C. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers.
D. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
E. Drawer Slides:
   1. Type: Full extension with overtravel.
   2. Static Load Capacity: Heavy Duty grade.
   4. Stops: Integral type.
5. Features: Provide self closing/stay closed type.

6. Manufacturers
   d. Substitutions: See Section 01 6000 - Product Requirements.

F. Hinges: European style concealed self-closing type, steel with satin finish.
   1. Manufacturers:
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.07 FABRICATION
   A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
   B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
   C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
   D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
   E. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.
   F. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify adequacy of backing and support framing.

3.02 INSTALLATION
   A. Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.
   B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
   C. Use fixture attachments in concealed locations for wall mounted components.
   D. Use concealed joint fasteners to align and secure adjoining cabinet units.
   E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
   F. Secure cabinets to floor using appropriate angles and anchorages.
   G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING
   A. Adjust installed work.
   B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING
   A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION
SECTION 07 1300
SHEET WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Sheet membrane waterproofing.
B. Below-grade waterproofing accessories.

1.02 RELATED REQUIREMENTS
A. Section 22 1006 - Plumbing Piping Specialties: Roof drain and plumbing vent flashing flanges.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for membrane.
C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
D. Certificate: Certify that products meet or exceed specified requirements.
E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE
A. Membrane Manufacturer Qualifications: Company specializing in waterproofing sheet membranes with three years experience.
B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience.

1.06 MOCK-UP
A. Construct mock-up 100 sq ft of horizontal waterproofed panel; to represent finished work including internal and external corners.
B. Locate where directed.
C. Mock-up may remain as part of the Work.

1.07 FIELD CONDITIONS
A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

1.08 WARRANTY
A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.
C. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.01 WATERPROOFING APPLICATIONS
A. Modified Bituminous Membrane Waterproofing: Use at below grade over ICFs.
   1. Vertical Surfaces: Adhesive bonded to substrate.
   2. Horizontal Surfaces: Adhesive bonded to substrate.
   3. Cover with drainage panel.
2.02 MEMBRANE MATERIALS

A. Modified Bituminous Membrane: Asphalt and polymer modifiers of styrene-butadiene-styrene (SBS) type, reinforced with non-woven polyester; smooth surfaced.

   1. Manufacturers:
      b. Substitutions: See Section 01 6000 - Product Requirements.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Membrane Sealant: As recommended by membrane manufacturer.

D. Adhesives: As recommended by membrane manufacturer.

E. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.

2.03 ACCESSORIES

A. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.

B. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.


C. Flexible Flashings: Type recommended by membrane manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.

C. Verify that items that penetrate surfaces to receive waterproofing are securely installed.

3.02 PREPARATION

A. Protect adjacent surfaces not designated to receive waterproofing.

B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.

C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.

D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.

E. Seal moving cracks with sealant, not rigid filler, using procedures recommended by sealant and waterproofing manufacturers.

F. Prepare building expansion joints as indicated on drawings.

G. Apply surface conditioner at a rate recommended by manufacturer. Protect conditioner from rain or frost until dry.

3.03 INSTALLATION - MEMBRANE

A. Install membrane waterproofing in accordance with manufacturer's instructions.

B. Roll out membrane. Minimize wrinkles and bubbles.

C. Self-Adhering Membrane: Remove release paper layer. Roll out on substrate with a mechanical roller to encourage full contact bond.

D. Overlap edges and ends and seal by method recommended by manufacturer, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.

E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.

F. Weather lap joints on sloped substrate in direction of drainage. Seal joints and seams.

G. Coordinate with drain installation; see Section 22 1006.
H. Install building expansion joints as indicated on drawings.
I. Install flexible flashings. Seal items penetrating through membrane with flexible flashings. Seal watertight to membrane.
J. Seal membrane and flashings to adjoining surfaces. Install termination bar at all edges. Install counterflashing over all exposed edges.

3.04 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD
A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions.
B. Place protection board directly against drainage panel; butt joints. Scribe and cut boards around projections, penetrations, and interruptions.
C. Adhere protection board to substrate with compatible adhesive.

3.05 FIELD QUALITY CONTROL
A. On completion of horizontal membrane installation, dam installation area in preparation for flood testing.
B. Flood to minimum depth of 1 inch with clean water. After 48 hours, inspect for leaks.
C. If leaking is found, remove water, repair leaking areas with new waterproofing materials as directed by Architect; repeat flood test. Repair damage to building.
D. When area is proven watertight, drain water and remove dam.

3.06 PROTECTION
A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Batt insulation and vapor retarder in exterior wall construction.
B. Batt insulation for filling interior walls, perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS
A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
B. Section 03 1119 - Insulating Concrete Forms: Polystyrene insulation used for forms.
C. Section 03 3000 - Cast-in-Place Concrete: Field-applied termiticide for concrete slabs and foundations.
D. Section 07 2500 - Weather Barriers: Separate air barrier and vapor retarder materials.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.05 FIELD CONDITIONS
A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS
A. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.

2.02 BATT INSULATION MATERIALS
A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
   4. Manufacturers:
c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com.

5. Substitutions: See Section 01 6000 - Product Requirements.

C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
   1. Where indicated, provide foil facing on one side; with flame spread index of 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   3. Manufacturers:
      c. ROXUL, Inc; ComfortBatt: www.roxul.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.03 ACCESSORIES
   A. Sheet Vapor Retarder: Specified in Section 07 2500.
   B. Insulation Fasteners: Appropriate for purpose intended.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

3.02 BATT INSTALLATION
   A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
   B. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
   C. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
   D. Tape seal tears or cuts in vapor retarder.
   E. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.
   F. Coordinate work of this section with requirements for vapor retarder specified in Section 07 2500.
   G. Coordinate work of this section with construction of air barrier seal specified in Section 07 2500.

3.03 PROTECTION
   A. Do not permit installed insulation to be damaged prior to its concealment.

   END OF SECTION
PART 1 GENERAL

SECTION INCLUDES

A. Water-Resistive Barrier: Under exterior wall cladding, over sheathing or other substrate; not air tight or vapor retardant.
B. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.
B. Section 07 2100 - Thermal Insulation: Vapor retarder installed in conjunction with batt insulation.

DEFINITIONS

A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.
C. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.

1. Water Vapor Permeance: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.

REFERENCE STANDARDS


SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on material characteristics.
C. Manufacturer’s Installation Instructions: Indicate preparation.

QUALITY ASSURANCE

A. Installer Qualifications: Company accredited and certified under the Air Barrier Association of America (ABAA) Quality Assurance Program (QAP).

FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 PRODUCTS

AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

A. Air Barrier Sheet, Self-Adhered:
   1. Air Permeance: 0.004 cubic feet per minute per square foot, maximum, when tested in accordance with ASTM E2178.
   2. Water Vapor Permeance: 10 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure A (desiccant procedure).
3. Ultraviolet and Weathering Resistance: Approved in writing by manufacturer for maximum of 150 days weather exposure.
4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less (Class A), when tested in accordance with ASTM E84.
5. Seam and Perimeter Tape: As recommended by sheet manufacturer.
6. Location: Entire perimeter of Collection Storage Rooms 109 and 204.
7. Products:
   c. Substitutions: See Section 01 6000 - Product Requirements.

2.02 VAPOR RETARDER MATERIALS (AIR BARRIER AND WATER-RESISTIVE)
   1. Type: Rubberized asphalt bonded to thermoplastic sheet, self-adhesive.
   2. Water Vapor Permeance: 0.05 perm, maximum, when tested in accordance with ASTM E96/E96M.
   3. Seam and Perimeter Tape: As recommended by sheet manufacturer.
   4. Location: Entire interior perimeter of Collection Storage Rooms 109 and 204.
   5. Products:
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.03 ACCESSORIES
A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.
C. Vapor Retarder Tape: Coated polyester film with acrylic adhesive backing; pressure sensitive.
D. Thinners and Cleaners: As recommended by material manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that surfaces and conditions are ready to accept the work of this section.

3.02 PREPARATION
A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

3.03 INSTALLATION
A. Install materials in accordance with manufacturer's instructions.
B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
C. Vapor Retarders: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
D. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.
E. Self-Adhesive Sheets:
   1. Prepare substrate in manner recommended by sheet manufacturer; fill and tape joints in substrate and between dissimilar materials.
   2. Lap sheets shingle-fashion to shed water and seal laps air tight.
3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that all laps are firmly adhered with no gaps or fishmouths.
4. Use same material, or other material approved by sheet manufacturer for the purpose, to seal to adjacent construction and as flashing.
5. At wide joints, provide extra flexible membrane allowing joint movement.

F. Openings and Penetrations in Exterior Weather Barriers:
1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with at least 4 inches wide; do not seal sill flange.
3. At openings to be filled with non-flanged frames, seal weather barrier to all sides of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.
4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.
5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

3.04 FIELD QUALITY CONTROL
A. Do not cover installed weather barriers until required inspections have been completed.
B. Obtain approval of installation procedures by the weather barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.
C. Take digital photographs of each portion of the installation prior to covering up.

3.05 PROTECTION
A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION
SECTION 07 4213
METAL WALL PANELS

PART 1  GENERAL

1.01  SECTION INCLUDES
A. Manufactured metal panels for walls, with related flashings and accessory components.

1.02  RELATED REQUIREMENTS
A. Section 07 2500 - Weather Barriers: Weather barrier under wall panels.

1.03  REFERENCE STANDARDS
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04  SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate dimensions, layout, joints, construction details, methods of anchorage.
C. Samples: Submit two samples of wall panel, 12 inch by 36 inch in size illustrating finish color, sheen, and texture.

1.05  QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
B. Installer Qualifications: Company specializing in installing the products specified in this section with minimum three years of documented experience.

1.06  DELIVERY, STORAGE, AND HANDLING
A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
B. Store prefinished material off ground and protected from weather. Prevent twisting, bending, or abrasion, and provide ventilation to stored materials. Slope metal sheets to ensure drainage.
C. Prevent contact with materials that may cause discoloration or staining of products.

1.07  WARRANTY
A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Correct defective work within a five year period after the Date of Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.
C. Correct defective Work within a five year period after the Date of Substantial Completion, including defects in water tightness and integrity of seals.

PART 2  PRODUCTS

2.01  MANUFACTURERS
A. Design is based on products manufactured by Steelogic (www.steelogic.com).
1. Substitutions: Are to have prior approvals. See Section 01 6000 - Product Requirements.

2.02  MANUFACTURED METAL PANELS
A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
1. Provide exterior panels and subgirt framing assembly.
2. Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall.
4. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement within system; movement between system and perimeter.

07 4213 - 1 METAL WALL PANELS
components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
5. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
6. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
7. Corners: Factory-fabricated in one continuous piece with minimum 18 inch returns.
8. Provide continuity of air barrier and vapor retarder seal at building enclosure elements in conjunction with materials specified in Section 07 2500.

B. Exterior Panels - MP-1:
1. Profile: DW-01; horizontal.
2. Material: Precoated aluminum sheet, 20 gage, 0.032 inch minimum thickness.
3. Panel Width: 12 inches.
5. Color: As selected by Architect from manufacturer's standard line.
   a. Symphony Kynar500 (PVDF) coating.
6. Texture: Smooth

C. Exterior Panels - MP-2:
1. Profile: DW-13; horizontal.
2. Material: Precoated aluminum sheet, 20 gage, 0.032 inch minimum thickness.
3. Panel Width: 12 inches.
5. Color: As selected by Architect from manufacturer's standard line.
   a. Symphony Kynar500 (PVDF) coating.
6. Texture: Smooth

D. Exterior Panels - MP-3:
1. Profile: DW-13; vertical.
2. Material: Precoated aluminum sheet, 20 gage, 0.032 inch minimum thickness.
3. Panel Width: 12 inches.
5. Color: As selected by Architect from manufacturer's standard line.
   a. Symphony Kynar500 (PVDF) coating.
6. Texture: Smooth

E. Subgirts:
1. Profile as indicated; to attach panel system to insulated concrete forms.

F. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.

G. Expansion Joints: Same material, thickness and finish as exterior sheets; 20 gage, 1-1/2 inch thick; manufacturer's standard brake formed type, of profile to suit system.

H. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
I. Anchors: Galvanized steel.

2.03 MATERIALS
A. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M Structural Steel (SS) or Forming Steel (FS), with G90/Z275 coating; continuous coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.04 ACCESSORIES
A. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.
B. Sealants:
1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
C. Fasteners: Manufacturer's standard type to suit application; steel, hot dip galvanized.
D. Field Touch-up Paint: As recommended by panel manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that building framing members are ready to receive panels.
B. Verify that weather barrier has been installed over substrate completely and correctly.

3.02 PREPARATION
A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane. Space at intervals indicated.

3.03 INSTALLATION
A. Install panels on walls in accordance with manufacturer's instructions.
B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.
C. Fasten panels to structural supports; aligned, level, and plumb.
D. Locate joints over supports. Lap panel ends minimum 2 inches.
E. Provide expansion joints where indicated.
F. Use concealed fasteners unless otherwise approved by Architect.
G. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.04 TOLERANCES
A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch.
B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch.

3.05 CLEANING
A. Remove site cuttings from finish surfaces.
B. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.
C. Upon completion of installation, thoroughly clean prefinished aluminum surfaces in accordance with AAMA 609 & 610.

END OF SECTION
SECTION 07 5419
PVC THERMOPLASTIC SINGLE-PLY ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Adhered system with PVC thermoplastic roofing membrane.
B. Insulation, flat and tapered.
C. Vapor retarder.
D. Deck sheathing.
E. Flashings.
F. Roofing stack boots, roofing expansion joints, and walkway pads.

1.02 RELATED REQUIREMENTS
A. Section 06 1000 - Rough Carpentry: Wood nailers and curbs.
B. Section 07 7100 - Roof Specialties: Prefabricated roofing expansion joint flashing.
C. Section 07 7200 - Roof Accessories: Roof-mounted units; prefabricated curbs.

1.03 REFERENCE STANDARDS
G. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; Factory Mutual System; 2006.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Convene one week before starting work of this section.
   1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's written information listed below.
   1. Product data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements.
C. Sustainable Design Documentation:
   1. Test report showing solar reflectance index of membrane
   2. Certification documenting recycled content.
   3. Documentation of distance to manufacturing facilities.
   4. Documentation of adhesive and sealant contents.
D. Manufacturer's Qualification Statement.
E. Installer's Qualification Statement.
F. Specimen Warranty: For approval.
G. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and setting plan for tapered insulation.
H. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
I. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
J. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
K. Warranty:
   1. Submit manufacturer warranty and ensure that forms have been completed in Owner’s name and registered with manufacturer.
   2. Submit installer's certification that installation complies with all warranty conditions for the waterproof membrane.

1.06 QUALITY ASSURANCE
A. Perform work in accordance with NRCA Roofing and Waterproofing Manual.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty (20) years of documented experience.
C. Installer Qualifications: Company specializing in performing the work of this section:
   1. With minimum five (5) years documented experience.
   2. Approved by membrane manufacturer.
   3. Extend manufacturer's labor and materials guarantee.
   4. Extend manufacturer's No Dollar Limit guarantee.
D. Single Source Responsibility: Provide and install products from single source.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
B. Store products in weather protected environment, clear of ground and moisture.
C. Protect foam insulation from direct exposure to sunlight.

1.08 FIELD CONDITIONS
A. Do not apply roofing membrane during unsuitable weather.
B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above 100 degrees F.
C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

1.09 WARRANTY
A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Material Warranty: Provide membrane manufacturer’s warranty agreeing to replace material that shows manufacturing defects within 10 years after installation.
C. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
   1. Warranty Term: 20 years.
   2. For repair and replacement include costs of both material and labor in warranty.
   3. Exceptions NOT Permitted:
      a. Damage due to roof traffic.
b. Damage due to wind of speed greater than 56 mph but less than 90 mph.

D. General Contractor's Warranty: Provide General Contractor's warranty for weathertightness of roofing system, including agreement to repair or replace roofing that fails to keep out water and snow within specified warranty period of 2 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 ROOFING APPLICATIONS

A. PVC Membrane Roofing: One ply membrane, fully adhered, over insulation.

B. Roofing Assembly Performance Requirements and Design Criteria:
      a. Field applied coating may not be used to achieve specified SRI.
   2. Wind Uplift:
      a. Designed to withstand wind uplift forces calculated with ASCE 7.
   3. Thermal Performance: Roof system insulation thermal value (R), minimum: 30; provide insulation of thickness required.
   4. Drainage: No standing water within 48 hours after precipitation.

2.02 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane:
   1. Material: Polyvinyl chloride complying with ASTM D4434/D4434M.
   3. Thickness: 60 mils (0.060 inch), minimum.
   4. Sheet Width: Factory fabricated into largest sheets possible.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Vapor Retarder: Material approved by roof manufacturer complying with requirements of fire rating classification; compatible with roofing and insulation materials.
   1. Fire-retardant adhesive.

D. Flexible Flashing Material: Same material as membrane.

E. Base Flashing: Provide waterproof, fully adhered base flashing system at all penetrations, plane transitions, and terminations.

2.03 DECK SHEATHING AND COVER BOARDS

A. Coverboard: Cement roof board, complying with ASTM C1325.
   1. Board Size: 48 by 96 inch.
   2. Board Thickness: 0.5 inch.

2.04 INSULATION

A. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, fiber reinforced felt both faces; Grade 2 and with the following characteristics:
   1. Compressive Strength: 25 psi.
   2. Tapered Board: Slope as indicated; minimum thickness 2 inch; fabricate of fewest layers possible.

2.05 ACCESSORIES

A. Prefabricated Flashing Accessories:
   1. Corners and Seams: Same material as membrane, in manufacturer's standard thicknesses.
   2. Penetrations: Same material as membrane, with manufacturer's standard cut-outs, rigid inserts, clamping rings, and flanges.
   3. Miscellaneous Flashing: Non-reinforced PVC membrane; 80 mils (0.080 inch) thick, in manufacturer's standard lengths and widths.

B. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.

C. Membrane Adhesive: As recommended by membrane manufacturer.

D. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

E. Sealants: As recommended by membrane manufacturer.

F. Cleaner: Manufacturer's standard, clear, solvent-based cleaner.

G. Edgings and Terminations: Manufacturer's standard edge and termination accessories.
   1. PVC Coated Sheet Metal.
   2. Termination Bar.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL
   A. Perform work in accordance with manufacturer's instructions.
   B. Do not apply roofing membrane during unsuitable weather.
   C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
   D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
   E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
   F. Coordinate the work with installation of associated counterflashings installed by other sections as the work of this section proceeds.
   G. When substrate preparation is responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.

3.02 EXAMINATION
   A. Verify that surfaces and site conditions are ready to receive work.
   B. Verify deck is supported and secure.
   C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
   D. Verify deck surfaces are dry and free of snow or ice.
   E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.03 PREPARATION, GENERAL
   A. Clean substrate thoroughly prior to roof application.
   B. Do not begin work until other work that requires foot or equipment traffic on roof is complete.
   C. Apply manufacturer's recommended vapor retarder or temporary roof before roof installation.

3.04 INSULATION
   A. Apply vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
      1. Extend vapor retarder under cant strips and blocking to deck edge.
      2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
   B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.
   C. Attachment of Insulation:
      1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual requirements.
2. Embed second layer of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.

D. Do not install wet, damaged, or warped insulation boards.

E. Lay subsequent layers of insulation with joints staggered minimum 6 inch from joints of preceding layer.

F. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

G. Lay boards with edges in moderate contact without forcing, and gap between boards no greater than 1/4 inch. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

H. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.

I. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches.

J. Do not apply more insulation than can be completely waterproofed in the same day.

3.05 MEMBRANE APPLICATION

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Fully Adhered Application: Apply adhesive to substrate at rate required by manufacturer. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.

D. Seam Welding:
   1. Seam Welding: Overlap edges and ends and seal seams by heat welding, minimum 2 inches.
   2. Cover all seams with manufacturer's recommended joint covers.
   3. Probe all seams once welds have thoroughly cooled. (Approximately 30 minutes.)
   4. Repair all deficient seams within the same day.
   5. Seal cut edges of reinforced membrane after seam probe is complete.

E. At intersections with vertical surfaces:
   1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
   2. Extend membrane over cant strips and up and over top of parapet wall.
   3. Fully adhere flexible flashing over membrane and up to reglets.
   4. Insert flashing into reglets and secure.

F. Install roofing expansion joints where indicated. Make joints watertight.

G. Install prefabricated joint components in accordance with manufacturer's instructions.

H. Coordinate installation of roof drains and sumps and related flashings.

I. Install walkway pads.

J. Daily Seal: Install daily seal per manufacturers instructions at the end of each work day. Prevent infiltration of water at incomplete flashings, terminations, and at unfinished membrane edges.

3.06 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field quality control and inspection.

B. Require site attendance of roofing and insulation material manufacturers daily during installation of the Work.

3.07 CLEANING

A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.
B. Remove wrappings, empty containers, paper, and other debris from the roof daily. Dispose of debris in compliance with local, State, and Federal regulations.
C. Remove bituminous markings from finished surfaces.
D. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
E. Repair or replace defaced or damaged finishes caused by work of this section.

3.08 PROTECTION
A. Protect installed roofing and flashings from construction operations.
B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION
SECTION 07 6200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fabricated sheet metal items, including flashings, counterflashings, and downspouts.
B. Sealants for joints within sheet metal fabrications.
C. Reglets and accessories.
D. Precast concrete splash pads.

1.02 RELATED REQUIREMENTS
A. Section 07 7100 - Roof Specialties: Manufactured copings, flashings, and expansion joint covers.
B. Section 07 7123 - Manufactured Gutters and Downspouts.
C. Section 07 7200 - Roof Accessories: Manufactured metal roof curbs.
D. Section 07 9200 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

1.03 REFERENCE STANDARDS
A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2015.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.06 QUALITY ASSURANCE
A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with five years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS
A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage (0.0239) inch thick base metal, shop pre-coated with PVDF coating.
2. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
3. Color: As selected by Architect from manufacturer's standard colors.

2.02 ACCESSORIES
A. Fasteners: Galvanized steel, with soft neoprene washers.
B. Slip Sheet: 45 mil thickness EPDM under splash block.
C. Primer: Zinc chromate type.
D. Protective Backing Paint: Zinc molybdate alkyd.
E. Sealant to be Concealed in Completed Work: Non-curing butyl sealant.
F. Sealant to be Exposed in Completed Work: ASTM C920; elastomeric sealant, 100 percent silicone with minimum movement capability of plus/minus 25 percent and recommended by manufacturer for substrates to be sealed; clear.
G. Plastic Cement: ASTM D4586, Type I.
H. Reglets: Recessed type, galvanized steel; face and ends covered with plastic tape.

2.03 FABRICATION
A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
B. Form pieces in longest possible lengths.
C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
F. Fabricate flashings to allow toe to extend 2 inches over roofing plane. Return and brake edges.

2.04 COLLECTOR HEAD AND DOWNSPOUT FABRICATION
A. Collector Heads: Profile as indicated.
B. Downspouts: Profile as indicated.
C. Accessories: Profiled to suit gutters and downspouts.
  1. Anchorage Devices: In accordance with SMACNA requirements.
  2. Gutter Supports: Brackets.
  3. Downspout Supports: Brackets.
D. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.
E. Seal metal joints.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION
A. Install starter and edge strips, and cleats before starting installation.
B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.
3.03 INSTALLATION

A. Insert flashings into reglets to form tight fit. Secure in place with lead wedges. Seal flashings into reglets with sealant.

B. Secure flashings in place using concealed fasteners.

C. Apply plastic cement compound between metal flashings and felt flashings.

D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

E. Seal metal joints watertight.

F. Secure gutters and downspouts in place using concealed fasteners.

G. Secure collector heads and downspouts in place using concealed fasteners.

H. Set splash pads under downspouts.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION
SECTION 07 7100
ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Manufactured roof specialties, including copings, fascias, gravel stops, and vents.
   B. Roof control and expansion joint covers.

1.02 RELATED REQUIREMENTS
   A. Section 07 7200 - Roof Accessories: Manufactured curbs, roof hatches, and snow guards.

1.03 REFERENCE STANDARDS
   C. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors’ National Association; 2012.

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
   C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
   D. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

1.05 QUALITY ASSURANCE
   A. Perform work in accordance with SMACNA (ASMM) details.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Control and Expansion Joint Covers:
      4. Substitutions: See Section 01 6000 - Product Requirements.
   B. Pipe and Penetration Flashings:
      2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COMPONENTS
   A. Control and Expansion Joint Covers: Composite construction of 8 inch wide flexible EPDM flashing of white color with closed cell urethane foam backing, each edge seamed to aluminum sheet metal flanges, designed for nominal joint width of 1 inch. Include special formed corners, tees, intersections, and wall flashings, each sealed watertight.
   B. Pipe and Penetration Flashing: Base of rounded aluminum, compatible with sheet metal roof systems, and capable of accommodating pipes sized between 0.375 inches and 12 inches.
      1. Caps: EPDM.

2.03 ACCESSORIES
   A. Sealant for Joints in Linear Components: As recommended by component manufacturer.
B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.
C. Roof Cement: ASTM D4586, Type I.

2.04 FINISHES
A. Clear Anodized Finish: AAMA 611 AA-M12C22A41 Class I clear anodic coating not less than 0.7 mils thick.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION
A. Install components in accordance with manufacturer's instructions.
B. Seal joints within components when required by component manufacturer.
C. Anchor components securely.
D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
E. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

END OF SECTION
SECTION 07 7200
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Manufactured curbs, equipment rails, and pedestals.

1.02 RELATED REQUIREMENTS
A. Section 07 6200 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.
B. Section 07 7100 - Roof Specialties: Other manufactured roof items.

1.03 REFERENCE STANDARDS
A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.
C. Shop Drawings: Submit detailed layout developed for this project. Show dimensioned location and number for each type of roof accessory.
D. Warranty Documentation:
   1. Submit manufacturer warranty.
   2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
   3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store products under cover and elevated above grade.

1.06 WARRANTY
A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURED CURBS
A. Manufactured Curbs, Equipment Rails, and Other Roof Mounting Assemblies: Factory-assembled hollow sheet metal construction with fully mitered and welded corners, integral counterflashing, internal reinforcing, and top side and edges formed to shed water.
   1. Sheet Metal: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33; G60 coating designation; 18 gage, 0.048 inch thick.
   2. Manufacture curb bottom and mounting flanges for installation directly on roof deck, not on insulation; match slope and configuration of roof deck.
   3. Provide the layouts and configurations shown on the drawings.
B. Curbs Adjacent to Roof Openings: Provide curb on all sides of opening, with top of curb horizontal for equipment mounting.
   1. Provide preservative treated wood nailers along top of curb.
   2. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.
3. Height Above Finished Roof Surface: 8 inches, minimum.
4. Height Above Roof Deck: 14 inches, minimum.
C. Pipe, Duct, and Conduit Mounting Pedestals: Vertical posts, minimum 8 inches square unless otherwise indicated.
   1. Provide sliding channel welded along top edge with adjustable height steel bracket, manufactured to fit item supported.
   2. Height Above Finished Roof Surface: 8 inches, minimum.
   3. Height Above Roof Deck: 14 inches, minimum.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Do not begin installation until substrates have been properly prepared.
   B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
3.02 PREPARATION
   A. Clean surfaces thoroughly prior to installation.
   B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
3.03 INSTALLATION
   A. Install in accordance with manufacturer’s instructions, in manner that maintains roofing weather integrity.
3.04 CLEANING
   A. Clean installed work to like-new condition.
3.05 PROTECTION
   A. Protect installed products until completion of project.
   B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Nonsag gunnable joint sealants.
B. Self-leveling pourable joint sealants.
C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS
A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.
B. Section 07 1300 - Sheet Waterproofing: Sealing cracks and joints in waterproofing substrate surfaces using materials specified in this section.
C. Section 07 2500 - Weather Barriers: Sealants required in conjunction with air barriers and vapor retarders.
D. Section 08 7100 - DOOR HARDWARE: Setting exterior door thresholds in sealant.
E. Section 08 8000 - Glazing: Glazing sealants and accessories.
F. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.03 REFERENCE STANDARDS
J. SWRI (VAL) - SWR Institute Validated Products directory; Sealant, Waterproofing and Restoration Institute; online at http://www.swrionline.org/ValidatedSealants.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Substrates for which use of primer is required.
   6. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
7. Certification by manufacturer indicating that product complies with specification requirements.
8. SWRI Validation: Provide currently available sealant product validations as published by SWRI for specified sealants.

C. Product Data for Accessory Products: Submit manufacturer’s technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

D. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.

E. Sustainable Design Documentation: For sealants and primers, submit VOC content and emissions documentation as specified in Section 01 6116.

F. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   3. Allow sufficient time for testing to avoid delaying the work.
   4. Deliver to manufacturer sufficient samples for testing.
   5. Report manufacturer’s recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
   6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nonsag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
   7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints: Seal open joints, whether or not the joint is indicated on the drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
a. Wall expansion and control joints.
b. Joints between door, window, and other frames and adjacent construction.
c. Joints between different exposed materials.
d. Openings below ledge angles in masonry.
e. Other joints indicated below.

2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.

a. Joints between door, window, and other frames and adjacent construction.
b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
   1) Exception: Such gaps and openings in gypsum board and plaster finished stud walls and suspended ceilings.
   2) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.

c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
d. Joints where installation of sealant is specified in another section.
e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use nonsag non-staining silicone sealant, unless otherwise indicated.

1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.
2. Lap Joints between Manufactured Metal Panels: Butyl rubber, non-curing.
3. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.

C. Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.

2. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; clear.
3. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.

D. Interior Wet Areas: Lab area at Secure Work 201; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.

E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.03 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products with levels of volatile organic compound (VOC) content as indicated in Section 01 6116.

B. Colors: As indicated on the drawings.

2.04 NONSAG JOINT SEALANTS

A. Type 1 - Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.

1. Movement Capability: Plus and minus 50 percent, minimum.
2. Non-Staining To Porous Stone: Non-staining to light-colored masonry when tested in accordance with ASTM C1248.
3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
5. Color: Match adjacent finished surfaces.
6. Cure Type: Single-component, neutral moisture curing.
7. Service Temperature Range: Minus 65 to 180 degrees F.
8. Products:
   a. Dow Corning Corporation; 756 SMS Building Sealant:
   b. Dow Corning Corporation; 790 Silicone Building Sealant:
   c. Dow Corning Corporation; 791 Silicone Weatherproofing Sealant:
   d. Pecora Corporation; 890FTS Field Tintable Ultra Low Modulus Architectural Silicone
   g. Substitutions: See Section 01 6000 - Product Requirements.

B. Type 2 - Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single
   component, mildew resistant; not expected to withstand continuous water immersion or traffic.
   2. Products:
      c. Substitutions: See Section 01 6000 - Product Requirements.

C. Type 3 - Nonsag "Traffic-Grade" Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A;
   single or multicomponent; explicitly approved by manufacturer for continuous water immersion
   and traffic without the necessity to recess sealant below traffic surface.
   2. Hardness Range: 40 to 50, Shore A, when tested in accordance with ASTM C661.
   3. Color: Match adjacent finished surfaces.
   4. Service Temperature Range: Minus 40 to 180 degrees F.

D. Type 4 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining,
   non-bleeding, non-sagging; not intended for exterior use.
   1. Color: Standard colors matching finished surfaces, Type OP (opaque).
   2. Grade: ASTM C834; Grade - Minus 18 Degrees C.
   3. Products:
      a. Pecora Corporation; AC-20 + Silicone Acrylic Latex Caulking Compound:
      b. Sherwin-Williams Company; White Lightning 3006 Siliconized Acrylic Latex Caulk:
      c. Sherwin-Williams Company; 950A Siliconized Acrylic Latex Caulk:
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.05 SELF-LEVELING SEALANTS

A. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or
   multicomponent; explicitly approved by manufacturer for traffic exposure; not expected to
   withstand continuous water immersion.

2.06 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to,
   compatible with specific sealant used, and recommended by backing and sealant
   manufacturers for specific application.
   1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B -
      Bi-Cellular Polyethylene.
   2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type C - Closed
      Cell Polyethylene.
   3. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that joints are ready to receive work.
B. Verify that backing materials are compatible with sealants.
C. Verify that backer rods are of the correct size.

3.02 PREPARATION
A. Remove loose materials and foreign matter that could impair adhesion of sealant.
B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION
A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
B. Perform installation in accordance with ASTM C1193.
C. Perform acoustical sealant application work in accordance with ASTM C919.
D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer.
E. Install bond breaker backing tape where backer rod cannot be used.
F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.04 POST-OCCUPANCY
A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at the low temperature in the thermal cycle. Report failures immediately and repair.

END OF SECTION
SECTION 07 9513
EXPANSION JOINT COVER ASSEMBLIES

PART 1  GENERAL

1.01  SECTION INCLUDES
A. Expansion joint cover assemblies for floor, wall, and ceiling surfaces.

1.02  RELATED REQUIREMENTS
A. Section 07 6200 - Sheet Metal Flashing and Trim: Roof expansion and control joint covers.
B. Section 07 7100 - Roof Specialties: Roof expansion and control joint covers.
C. Section 07 9200 - Joint Sealants: Sealing expansion and control joints using gunnable and pourable sealants.

1.03  REFERENCE STANDARDS

1.04  ADMINISTRATIVE REQUIREMENTS
A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.05  SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.
C. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, effected adjacent construction and anchorage locations.
D. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

PART 2  PRODUCTS

2.01  MANUFACTURERS
A. Expansion Joint Cover Assemblies:
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02  EXPANSION JOINT COVER ASSEMBLY APPLICATIONS
A. Interior Floor Joints Subject to Seismic Movement:
   1. Products:
      c. [F03 - Nystrom; EJ-PTS-1500: www.nystrom.com].
      d. Substitutions: See Section 01 6000 - Product Requirements.
B. Interior Wall/Ceiling Joints Subject to Seismic Movement:
   1. Products:
      b. W01 - Nystrom: EJ-FCT-600w: www.nystrom.com (use where corners are formed).
c. Substitutions: See Section 01 6000 - Product Requirements.

C. Exterior Roof to Wall Joints Subject to Seismic Movement:
1. Products:
   b. Substitutions: See Section 01 6000 - Product Requirements.

D. Exterior Wall Joints Subject to Seismic Movement:
1. Products:
   b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 EXPANSION JOINT COVER ASSEMBLIES

A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
   1. Joint Dimensions and Configurations: As indicated on drawings.
   2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
   3. Joint Cover Styles: As indicated on drawings.
   4. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
   5. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
   6. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.

B. Floor Joint Covers: Coordinate with indicated floor coverings.

C. Resilient Seal Type Covers: Having flat exposed surface without crevices that could collect dirt; designed to withstand expected movement without extrusion of seal from joint assembly; for floors, provide style that is flush with top of floor covering; for exterior joints, weathertight.

D. Sliding Cover Plate Type Covers: Provide plate with beveled edges and neat fit that does not collect dirt.

E. Covers In Fire Rated Assemblies: Provide cover assembly having fire rating equivalent to that of assembly into which it is installed.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
   1. Exposed Finish Outdoors: Natural anodized.
   2. Exposed Finish at Floors: Mill finish or natural anodized.
   3. Exposed Finish at Walls and Ceilings: Natural anodized.

B. Resilient Seals:
   1. For Ceilings: Any resilient material, flush, pleated, or hollow gasket.
   2. For Pedestrian Traffic Applications: EPDM rubber, Neoprene, or Santoprene; no PVC; Shore A hardness of 40 to 50 Durometer.
   3. For Vehicular Traffic Applications: EPDM rubber, Neoprene, or Santoprene; no PVC; Shore A hardness of 40 to 50 Durometer.
   4. Color: As selected from manufacturer's standard line of colors.

C. Anchors and Fasteners: As recommended by cover manufacturer.

D. Threaded Fasteners: Aluminum.

E. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.
PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.
   B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.

3.02 INSTALLATION
   A. Install components and accessories in accordance with manufacturer's instructions.
   B. Align work plumb and level, flush with adjacent surfaces.
   C. Rigidly anchor to substrate to prevent misalignment.

3.03 PROTECTION
   A. Do not permit traffic over unprotected floor joint surfaces.
   B. Provide strippable coating to protect finish surface.

END OF SECTION
SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Non-fire-rated hollow metal doors and frames.
B. Fire-rated hollow metal doors and frames.
C. Thermally insulated hollow metal doors with frames.
D. Sound-rated hollow metal doors and frames.
E. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS
A. Section 08 7100 - DOOR HARDWARE.
B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.

1.03 ABBREVIATIONS AND ACRONYMS
B. ASCE - American Society of Civil Engineers.
C. HMMA - Hollow Metal Manufacturers Association.
D. NAAMM - National Association of Architectural Metal Manufacturers.
F. SDI - Steel Door Institute.
G. UL - Underwriters Laboratories.

1.04 REFERENCE STANDARDS
C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
F. 5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
L. ASTM E413 - Classification for Rating Sound Insulation; 2010.
M. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014 (ANSI/BHMA A156.115).
Q. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
T. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.
V. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
W. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
X. UL 1784 - Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives; Current Edition, Including All Revisions.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.06 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
B. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes installation requirements.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Hollow Metal Doors and Frames:
   6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DESIGN CRITERIA
A. Requirements for Hollow Metal Doors and Frames:
1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
2. Accessibility: Comply with ICC A117.1 and ADA Standards.
3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
4. Door Edge Profile: Manufacturers standard for application indicated.
5. Typical Door Face Sheets: Flush.
7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
8. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section Door Hardware.
9. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
   a. Based on NAAMM HMMA Custom Guidelines: Provide at least A25/ZF75 (galvannealed) for interior applications, and at least A60/ZF180 (galvannealed) or G60/Z180 (galvanized) for corrosive locations.
B. Electrical Raceways: Provide hollow metal doors to receive electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through-wire transfer hardware or wiring harness specified in hardware sets in Division 08 Sections Door Hardware and Access Control Hardware. Wire nut connections are not acceptable.
C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS
A. Exterior Doors: Thermally insulated.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 2 - Heavy-duty.
      b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
      e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
   2. Core Material: Polyurethane, 1.8 lbs/cu ft minimum density.
   3. Door Thermal Resistance: R-Value of 8.7, minimum, for installed thickness of polyurethane.
   5. Weatherstripping: Refer to Section 08 7100.
B. Interior Doors, Non-Fire Rated:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 2 - Heavy-duty.
      b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
e. Zinc Coating: Not required; ASTM A653/A653M.

2. Core Material: Manufacturers standard core material/construction and in compliance with requirements.


C. Fire-Rated Doors:

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 2 - Heavy-duty.
   b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 1 - Full Flush.
   d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
   e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.

2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").

3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
   a. Attach fire rating label to each fire rated unit.

4. Core Material: Manufacturers standard core material/construction in compliance with requirements.


D. Sound-Rated Interior Doors at Staging Work 200

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 4 - Maximum-duty.
   b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 1 - Full Flush.
   d. Door Face Metal Thickness: 14 gage, 0.067 inch, minimum.
   e. Zinc Coating: Not required; ASTM A653/A653M.

2. Sound Transmission Class (STC) Rating of Door and Frame Assembly: STC of 45, calculated in accordance with ASTM E413, and tested in accordance with ASTM E90.

3. Core Material: Manufacturer's standard construction as required to meet acoustic requirements indicated.

4. Door Thickness: As required to meet acoustic requirements indicated.

5. Steel stiffened


7. Sound Seals: Integral, concealed in door and/or frame.


2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Exterior Door Frames: Full profile/continuously welded type.
   1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
   2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
   3. Frame Finish: Factory primed and field finished.
   4. Weatherstripping: Separate, see Section 08 7100.

C. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
   1. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
   2. Frame Finish: Factory primed and field finished.

D. Door Frames, Fire-Rated: Full profile/continuously welded type.
   1. Fire Rating: Same as door, labeled.
2. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
3. Frame Finish: Factory primed and field finished.

E. Sound-Rated Door Frames at Gallery/Work Area: Full profile/continuously welded type.
   1. Frame Metal Thickness: 14 gage, 0.067 inch, minimum.
   2. Frame Finish: Factory primed and field finished.

F. Electrical Knock Out Boxes: Factory weld 18 gauge electrical knock out boxes to frame for electrical hardware preps; including but not limited to, electric through wire transfer hardware, electrical raceways and wiring harnesses, door position switches, electric strikes, magnetic locks, and jamb mounted card readers as specified in hardware sets in Division 08 Sections Door Hardware and Access Control Hardware.
   1. Provide electrical knock out boxes with a dual 1/2-inch and 3/4-inch knockouts.
   2. Conduit to be coordinated and installed in the field (Division 26) from middle hinge box and strike box to door position box.
   3. Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Division 08 Section Door Hardware.
   4. Electrical knock out boxes for continuous hinges are located in the center of the vertical dimension on the hinge jamb.

G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

H. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

I. Frames Wider than 48 Inch: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 ACCESSORIES

A. Glazing: As specified in Section 08 8000.

B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.

C. Astragals for Double Doors: Specified in Section 08 7100.

D. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.

E. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.

F. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

2.06 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
B. Install fire rated units in accordance with NFPA 80.
C. Coordinate frame anchor placement with wall construction.
D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
E. Coordinate installation of hardware.
F. Coordinate installation of glazing.
G. Coordinate installation of electrical connections to electrical hardware items.
H. Touch up damaged factory finishes.

3.04 TOLERANCES
A. Clearances Between Door and Frame: Comply with related requirements of specified door and frame standards or custom guidelines indicated.
B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.05 ADJUSTING
A. Adjust for smooth and balanced door movement.
B. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

3.06 SCHEDULE
A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION
SECTION 08 3323
OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Overhead coiling doors, operating hardware, fire-rated and non-fire-rated, manual and electric operation.
B. Wiring from electric circuit disconnect to operator to control station.

1.02 RELATED REQUIREMENTS
A. Section 26 2717 - Equipment Wiring: Power to disconnect.

1.03 REFERENCE STANDARDS
A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2014.
E. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2014.
H. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide general construction, electrical equipment, and component connections and details.
C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
D. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.
E. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.05 QUALITY ASSURANCE
A. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Overhead Coiling Fire Doors:
   5. Substitutions: See Section 01 6000 - Product Requirements.
2.02 COILING DOORS

A. Non-Fire-Rated Interior Coiling Doors: Steel slat curtain.
   1. Single thickness slats.
   2. Nominal Slat Size: 2 inches wide x required length.
   3. Finish: Factory painted, color as selected.
   5. Hood Enclosure: Manufacturer's standard; color as selected from manufacturer's standard line of colors.
   7. Mounting: Surface mounted.

B. Fire-Rated Coiling Doors: Steel slat curtain; conform to NFPA 80.
   1. Three (3) hour fire rating.
   2. Provide products listed and labeled by ITS (DIR) or UL (DIR) as suitable for the purpose specified and indicated.
   3. Oversized Openings: Provide certificate of compliance from Authority Having Jurisdiction indicating approval of fire rated units and operating hardware assembly.
   4. Nominal Slat Size: 2 inches wide by required length.
   5. Finish: Factory painted, color as selected from manufacturer's standard line of finishes.
   7. Hood Enclosure: Manufacturer's standard; color as selected from manufacturer's standard line of colors.
   10. Mounting: Surface mounted.

2.03 MATERIALS

A. Curtain Construction: Interlocking slats.
   1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
   2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.
   3. Weatherstripping: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.

B. Steel Slats: Minimum thickness, 18 gage, 2 inch; ASTM A653/A653M galvanized steel sheet.

C. Guide Construction: Continuous, of profile to retain door in place with snap-on trim, mounting brackets of same metal.

D. Steel Guides: Formed from galvanized steel sheet, 14 gage, 1/4 inch thick; 1-1/2 inch wide; complying with ASTM A653/A653M.
   1. Prime paint.

E. Hood Enclosure: Internally reinforced to maintain rigidity and shape.
   1. Prime paint.

F. Lock Hardware:
   1. For motor operated units, additional lock or latching mechanisms are not required.

G. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

2.04 ELECTRIC OPERATION

A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
   1. Provide interlock switches on motor operated units.
B. Electric Operators:
   1. Mounting: Side mounted.
   2. Motor Enclosure:
      a. Interior Doors: NEMA MG 1, Type 1; TEFC.
   3. Motor Rating: 1/2 hp; continuous duty.
   4. Motor Voltage: 120 volt, single phase, 60 Hz.
   7. Opening Speed: 12 inches per second.
C. Control Station: Standard three button (OPEN-STOP-CLOSE) momentary control for each operator.
   1. 24 volt circuit.
   2. Surface mounted.
D. Safety Edge: Located at bottom of curtain, full width, electro-mechanical sensitized type, wired to stop operator upon striking object, hollow neoprene covered.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION
   A. Install units in accordance with manufacturer's instructions.
   B. Install fire-rated doors in accordance with NFPA 80.
   C. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
   D. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
   E. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
   F. Coordinate installation of electrical service with Section 26 2717.
   G. Complete wiring from disconnect to unit components.
   H. Complete wiring from fire alarm system.
   I. Install perimeter trim and closures.

3.03 TOLERANCES
   A. Maintain dimensional tolerances and alignment with adjacent work.
   B. Maximum Variation From Plumb: 1/16 inch.
   C. Maximum Variation From Level: 1/16 inch.
   D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 ADJUSTING
   A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING
   A. Clean installed components.
   B. Remove labels and visible markings.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Overhead sectional doors, electrically operated.
B. Operating hardware and supports.
C. Electrical controls.

1.02 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
C. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2014.
D. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
C. Product Data: Show component construction, anchorage method, and hardware.
D. Manufacturer's Installation Instructions: Include any special procedures required by project conditions.
E. Operation Data: Include normal operation, troubleshooting, and adjusting.
F. Maintenance Data: Include data for motor and transmission, shaft and gearing, lubrication frequency, spare part sources.
G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner’s name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years of experience.
C. Conform to applicable code for motor and motor control requirements.
D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals for warranty requirements.
B. Correct defective Work within a five year period after Date of Substantial Completion.
C. Warranty: Include coverage for electric motor and transmission.
D. Provide five year manufacturer warranty for electric operating equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sectional Doors:
4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 STEEL DOOR COMPONENTS
A. Steel Doors: Flush steel, insulated; standard lift operating style with track and hardware; complying with DASMA 102, Commercial application.
   1. Door Nominal Thickness: 2 inches thick.
   2. Exterior Finish: Factory finished with acrylic baked enamel; color as selected by Architect.
   3. Interior Finish: Factory finished with acrylic baked enamel; color as selected from manufacturers standard line.
B. Door Panels: Steel construction; outer steel sheet of 20 gage, 0.0359 inch minimum thickness, flush profile; inner steel sheet of 20 gage, 0.0359 inch minimum thickness, flat profile; core reinforcement sheet steel roll formed to channel shape, rabbeted weather joints at meeting rails; polyurethane insulation.

2.03 DOOR COMPONENTS
A. Track: Rolled galvanized steel, 0.090 inch minimum thickness; 3 inch wide, continuous one piece per side; galvanized steel mounting brackets 1/4 inch thick.
B. Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of galvanized steel; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.
C. Lift Mechanism: Torsion spring on cross head shaft, with braided galvanized steel lifting cables.
D. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.
E. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.
F. Head Weatherstripping: EPDM rubber seal, one piece full length.
G. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.

2.04 MATERIALS
A. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G60/Z180 coating, plain surface.
B. Insulation: Foamed-in-place polyurethane, bonded to facing.

2.05 ELECTRICAL OPERATION
A. Electrical Characteristics:
   1. 1/2 hp; manually operable in case of power failure, transit speed of 12 inches per second.
   2. 120 volts, single phase, 60 Hz.
B. Motor: NEMA MG 1, Type 1.
C. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
D. Disconnect Switch: Factory mount disconnect switch in control panel.
E. Electric Operator: Side mounted on cross head shaft, adjustable safety friction clutch; brake system actuated by independent voltage solenoid controlled by motor starter; enclosed gear driven limit switch; enclosed magnetic cross line reversing starter; mounting brackets and hardware.
F. Safety Edge: At bottom of door panel, full width; electro-mechanical sensitized type, wired to stop door upon striking object; hollow neoprene covered to provide weatherstrip seal.
G. Control Station: Standard three button (open-close-stop) momentary type control for each electric operator.
1. 24 volt circuit.
2. Surface mounted.
3. Locate at inside door jamb in Collections Storage.

H. Hand Held Transmitter: Digital control, resettable.
   1. Provide two transmitters per overhead door opener.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
   B. Verify that electric power is available and of the correct characteristics.

3.02 PREPARATION
   A. Prepare opening to permit correct installation of door unit to perimeter air and vapor barrier seal.
   B. Apply primer to wood frame.

3.03 INSTALLATION
   A. Install door unit assembly in accordance with manufacturer’s instructions.
   B. Anchor assembly to wall construction and building framing without distortion or stress.
   C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
   D. Fit and align door assembly including hardware.
   E. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.
   F. Install perimeter trim.

3.04 TOLERANCES
   A. Maximum Variation from Plumb: 1/16 inch.
   B. Maximum Variation from Level: 1/16 inch.
   C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch from 10 ft straight edge.
   D. Maintain dimensional tolerances and alignment with adjacent work.

3.05 ADJUSTING
   A. Adjust door assembly for smooth operation and full contact with weatherstripping.
   B. Have manufacturer’s field representative present to confirm proper operation and identify adjustments to door assembly for specified operation.

3.06 CLEANING
   A. Clean doors and frames.
   B. Remove temporary labels and visible markings.

3.07 PROTECTION
   A. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

END OF SECTION
SECTION 08 4413
GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed curtain wall, with vision glazing and glass infill panels.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.
B. Section 08 8000 - Glazing.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2015.
B. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; 2009 (part of AAMA 501).
E. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers; 2010, with 2013 Supplements and Errata.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
C. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
D. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure.
E. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.
F. Field Quality Control Submittals: Report of field testing for water leakage.
G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE
A. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Handle products of this section in accordance with AAMA CW-10.
B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS
A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY
A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a five year period after Date of Substantial Completion.
C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 CURTAIN WALL
A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Inside glazed, with pressure plate and mullion cover, where indicated on drawings.
   2. Fabrication Method: Either shop/factory or field fabricated system.
   3. Glazing Method: Either shop/factory or field glazed system.
   4. Vertical Mullion Face Width: 2-1/2 inches.
   6. Finish: Class I natural anodized.
      a. Factory finish surfaces that will be exposed in completed assemblies.
      b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
   7. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   9. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   10. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
   11. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.

1. Design Wind Loads: Comply with the following:
   a. Measure performance by testing in accordance with ASTM E330/E330M, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
   b. Member Deflection: For spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch, whichever is less and with full recovery of glazing materials.
   c. Member Deflection: For spans over 13 feet 6 inches and less than 40 feet, limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch, with full recovery of glazing materials.

2. Seismic Loads: Design and size components to withstand seismic loads and sway displacement in accordance with requirements of ASCE 7.

3. Wind-Borne-Debris Resistance: Identical full-size glazed assembly without auxiliary protection tested by independent agency in accordance with ASTM E1996 for Wind Zone 2 - Enhanced Protection for Large and Small Missile impact and pressure cycling at design wind pressure.

4. Movement: Accommodate the following movement without damage to components or deterioration of seals:
   a. Expansion and contraction caused by 180 degrees F surface temperature.
   b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
   c. Movement of curtain wall relative to perimeter framing.
   d. Deflection of structural support framing, under permanent and dynamic loads.

C. Water Penetration Resistance: No uncontrolled water on indoor face when tested as follows:

1. Test Pressure Differential: 10 psf.

D. Air Leakage: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.

E. Thermal Performance Requirements:

1. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.

2.02 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.

   1. Cross-Section: As indicated on drawings.

B. Glazing: As specified in Section 08 8000.

2.03 MATERIALS


B. Weatherseal Sealant: Silicone, with adhesion in compliance with ASTM C794; compatible with glazing accessories.

C. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, and compatible with flashing material.

D. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

E. Glazing Accessories: As specified in Section 08 8000.

2.04 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify dimensions, tolerances, and method of attachment with other related work.
   B. Verify that curtain wall openings and adjoining air and vapor seal materials are ready to receive work of this section.
   C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION
   A. Install curtain wall system in accordance with manufacturer's instructions.
   B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
   C. Provide alignment attachments and shims to permanently fasten system to building structure.
   D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
   E. Provide thermal isolation where components penetrate or disrupt building insulation.
   F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
   G. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
   H. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES
   A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.
   B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
   C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.04 FIELD QUALITY CONTROL
   A. Provide the services of the manufacturer's field representative to observe installation and make report.
   B. See Section 01 4000 - Quality Requirements, for general requirements for testing and inspection.
   C. Test installed curtain wall for water leakage in accordance with AAMA 501.2.
   D. Replace curtain wall components that have failed field testing and retest until performance is satisfactory.

3.05 ADJUSTING
   A. Adjust operating sash for smooth operation.

3.06 CLEANING
   A. Remove protective material from pre-finished aluminum surfaces.
   B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

END OF SECTION
SECTION 08 5113
ALUMINUM WINDOWS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Extruded aluminum windows with fixed sash and operating sash.
B. Factory glazing.
C. Operating hardware.
D. Insect screens.

1.02 RELATED REQUIREMENTS
A. Section 07 2500 - Weather Barriers: Sealing frame to weather barrier installed on adjacent construction.
B. Section 07 9200 - Joint Sealants: Sealing joints between window frames and adjacent construction.
C. Section 08 8000 - Glazing.

1.03 REFERENCE STANDARDS
B. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide component dimensions.
C. Shop Drawings: Indicate opening dimensions, elevations of different types, framed opening tolerances, method for achieving air and vapor barrier seal to adjacent construction, anchorage locations, and installation requirements.

D. Samples: Submit two samples, 12 by 12 inch in size illustrating typical corner construction, accessories, and finishes.

E. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
   1. Evidence of AAMA Certification.
   2. Evidence of WDMA Certification.
   3. Evidence of CSA Certification.
   4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.

F. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements in excess of those prescribed by specified grade.

G. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.

1.06 QUALITY ASSURANCE
   A. Manufacturer and Installer Qualifications: Company specializing in fabrication of commercial aluminum windows of types required, with not fewer than three years of experience.

1.07 DELIVERY, STORAGE, AND HANDLING
   A. Comply with requirements of AAMA CW-10.
   B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.08 FIELD CONDITIONS
   A. Do not install sealants when ambient temperature is less than 40 degrees F.
   B. Maintain this minimum temperature during and 24 hours after installation of sealants.

1.09 WARRANTY
   A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
   B. Correct defective Work within a five year period after the Date of Substantial Completion.
   C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
   D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 WINDOWS
   A. Aluminum Windows: Extruded aluminum frame and sash, factory fabricated, factory finished, with operating hardware, related flashings, and anchorage and attachment devices.
      1. Frame Depth: 4 inches.
      2. Operable Units: Double weatherstripped.
      3. Provide units factory glazed.
      4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for operating hardware and imposed loads.
      5. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
6. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
8. Thermal Movement: Design to accommodate thermal movement caused by 180 degrees F surface temperature without buckling stress on glass, joint seal failure, damaging loads on structural elements, damaging loads on fasteners, reduction in performance or other detrimental effects.

B. Performance Requirements: Provide products that comply with the following:
1. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific window type:
   a. Performance Class (PC): CW.
   b. Performance Grade (PG): Equivalent to or greater than specified design pressure.
2. Design Pressure (DP): In accordance with applicable codes.
3. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
4. Wind-Borne-Debris Resistance: Identical full-size glazed assembly without auxiliary protection, tested by independent agency in accordance with ASTM E1996 for Wind Zone 2 - Enhanced Protection for Large and Small Missile impact and pressure cycling at design wind pressure.
5. Water Leakage: No uncontrolled leakage on interior face when tested in accordance with ASTM E331 at differential pressure of 12.11 psf.
6. Air Leakage: Maximum of 0.1 cu ft/min sq ft per unit area of outside frame dimension, with 6.27 psf differential pressure when tested in accordance with ASTM E283.
7. Condensation Resistance Factor of Frame: 50, measured in accordance with AAMA 1503.
8. Overall U-value, Including Glazing: 0.35, maximum, measured on the window size required for this project.
9. Forced Entry Resistance: Tested to comply with ASTM F588 requirements for performance level of Grade 20 for specific window style required.

C. Fixed, Non-Operable Type:
2. Glazing: Single; gray tinted; low-e.
4. Interior Finish: Class I natural anodized.

D. Outswinging Casement Type:
2. Provide screens.
3. Glazing: Double; gray tinted; low-e.
5. Interior Finish: Class I natural anodized.

2.02 COMPONENTS

A. Frames: 2 inch wide by 4 inch deep profile; thermally broken with interior portion of frame insulated from exterior portion; flush glass stops of snap-on type.

B. Glazing: As specified in Section 08 8000.

C. Insect Screens: Extruded aluminum frame with mitered and reinforced corners; screen mesh taut and secure to frame; secured to window with adjustable hardware allowing screen removal without use of tools.
1. Hardware: Spring loaded steel pins; four per screen unit.
2. Screen Mesh: Vinyl-coated fiberglass, window manufacturer's standard mesh.
3. Frame Finish: Same as frame and sash.
D. Operable Sash Weatherstripping: Wool pile; permanently resilient, profiled to achieve effective weather seal.
E. Glazing Materials: As specified in Section 08 8000.
F. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

### 2.03 MATERIALS
A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

### 2.04 HARDWARE
A. Sash lock: Lever handle with cam lock.
B. Operator: Lever action handle fitted to projecting sash arms with limit stops.
C. Projecting Sash Arms: Cadmium plated steel, friction pivot joints with nylon bearings, removable pivot clips for cleaning.
D. Pulls: Manufacturer's standard type.
E. Limit Stops: Resilient rubber.

### 2.05 FINISHES
A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

### PART 3 EXECUTION

#### 3.01 EXAMINATION
A. Verify that wall openings and adjoining air and vapor seal materials are ready to receive aluminum windows.

#### 3.02 INSTALLATION
A. Install windows in accordance with manufacturer's instructions.
B. Install windows in accordance with ASTM E2112.
C. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
D. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.
E. Install sill and sill end angles.
F. Set sill members and sill flashing in continuous bead of sealant.
G. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
H. Install operating hardware not pre-installed by manufacturer.
I. Install glass and infill panels in accordance with requirements specified in Section 08 8000.

#### 3.03 TOLERANCES
A. Maximum Variation from Level or Plumb: 1/16 inches every 3 ft non-cumulative or 1/8 inches per 10 ft, whichever is less.

#### 3.04 FIELD QUALITY CONTROL
A. Test installed windows for compliance with performance requirements for water penetration, in accordance with ASTM E1105 using uniform pressure and the same pressure difference as specified for laboratory testing.
   1. Test all windows.
   2. If any window fails, test additional windows at Contractor's expense.
B. Replace windows that have failed field testing and retest until performance is satisfactory.
3.05 ADJUSTING
   A. Adjust hardware for smooth operation and secure weathertight closure.

3.06 CLEANING
   A. Remove protective material from factory finished aluminum surfaces.
   B. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.
   C. Remove excess glazing sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for hollow metal doors.
B. Hardware for fire-rated doors.
C. Electrically operated and controlled hardware.
D. Lock cylinders for doors that hardware is specified in other sections.
E. Thresholds.
F. Weatherstripping, seals and door gaskets.

1.02 RELATED REQUIREMENTS

A. Section 08 1113 - Hollow Metal Doors and Frames.
B. Section 08 3323 - Overhead Coiling Doors: Lockable coiling doors.
C. Section 08 7110 - Basis of Design Door Hardware - Hager.
D. Section 28 1300 - Access Control: Electronic access control devices.

1.03 REFERENCE STANDARDS

C. BHMA A156.1 - American National Standard for Butts and Hinges; Builders Hardware Manufacturers Association, Inc.; 2013 (ANSI/BHMA A156.1).
D. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches; Builders Hardware Manufacturers Association; 2011 (ANSI/BHMA A156.2).
E. BHMA A156.4 - American National Standard for Door Controls - Closers; Builders Hardware Manufacturers Association, Inc.; 2013 (ANSI/BHMA A156.4).
F. BHMA A156.7 - American National Standard for Template Hinge Dimensions; Builders Hardware Manufacturers Association; 2014 (ANSI/BHMA A156.7).
G. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; Builders Hardware Manufacturers Association, Inc.; 2010 (ANSI/BHMA A156.8).
I. BHMA A156.18 - American National Standard for Materials and Finishes; Builders Hardware Manufacturers Association, Inc.; 2012 (ANSI/BHMA A156.18).
J. BHMA A156.21 - American National Standard for Thresholds; Builders Hardware Manufacturers Association; 2014 (ANSI/BHMA A156.21).
K. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems, Builders Hardware Manufacturers Association; 2012 (ANSI/BHMA A156.22).
L. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014 (ANSI/BHMA A156.115).
M. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; Door and Hardware Institute; 2004.
O. NFPA 70 - National Electrical Code

1.04 ADMINISTRATIVE REQUIREMENTS
A. Coordinate the manufacture, fabrication, and installation of products that door hardware will be installed upon.
B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
C. Convey Owner’s keying requirements to manufacturers.
D. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; require attendance by all affected installers.
E. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
F. Keying Conference: Conduct conference to comply with requirements in Division 01 Section Project Meetings. Keying conference to incorporate the following criteria into the final keying schedule document:
   1. Function of building, purpose of each area and degree of security required.
   2. Plans for existing and future key system expansion.
   3. Requirements for key control storage and software.
   4. Installation of permanent keys, cylinder cores and software.
   5. Address and requirements for delivery of keys.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project.
C. Hardware Schedule: Detailed listing of each item of hardware to be installed on each door. Use door numbering scheme as included in the Contract Documents. Identify electrically operated items and include power requirements.
D. Keying Schedule: Submit for approval of Owner.
E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
F. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
   1. Submit manufacturer's parts lists and templates.
G. Keys: Deliver with identifying tags to Owner by security shipment direct from hardware supplier.
H. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
I. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
J. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Lock Cylinders: Ten for each master keyed group.
   3. Tools: One set of all special wrenches or tools applicable to each different or special hardware component, whether supplied by the hardware component manufacturer or not.
1.06 QUALITY ASSURANCE
   A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.
   B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
   C. Hardware Supplier Qualifications: Company specializing in supplying commercial door hardware with five years of experience.

1.07 DELIVERY, STORAGE, AND HANDLING
   A. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

1.08 WARRANTY
   A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
   B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
      1. Structural failures including excessive deflection, cracking, or breakage.
      2. Faulty operation of the hardware.
      3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      4. Electrical component defects and failures within the systems operation.
   C. Special Warranty Periods:
      1. Ten years for mortise locks and latches.
      2. Five years for exit hardware.
      3. Twenty five years for manual surface door closer bodies.
      4. Two years for electromechanical door hardware.
   D. Provide twenty five year warranty for manual surface door closer bodies.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Allegion Brands; Ives, LCN, Schlage, Steelcraft, or Von Duprin: www.allegion.com/us.
   F. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DOOR HARDWARE - GENERAL
   A. Provide hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.
   B. Provide items of a single type of the same model by the same manufacturer.
   C. Provide products that comply with the following:
      1. Applicable provisions of federal, state, and local codes.
      5. Hardware on Fire-Rated Doors, Except Hinges: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.
7. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

D. Function: Lock and latch function numbers and descriptions of manufactures series as listed in hardware schedule.

E. Electrically Operated and/or Controlled Hardware: Provide all power supplies, power transfer hinges, relays, and interfaces required for proper operation; provide wiring between hardware and control components and to building power connection.

F. Finishes: Provide door hardware of the same finish unless otherwise indicated.
   1. Primary Finish: Satin chrome plated over nickel on brass or bronze, 626 (approx US26D).
   2. Secondary Finish: Satin chrome plated over nickel on brass or bronze, 626 (approx US26D).
   3. Finish Definitions: BHMA A156.18.
   4. Exceptions:
      a. Where base metal is specified to be different, provide finish that is an appearance equivalent according to BHMA A156.18.
      c. Door Closer Covers and Arms: Color to be selected by Architect from manufacturer's standard colors.

G. Fasteners:

2.03 LOCKS AND LATCHES

A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
   1. Hardware Sets indicate locking functions required for each door.
   2. If no hardware set is indicated for a swinging door provide an office lockset.
   3. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
   4. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
   5. In door sections, where a lock cylinder referenced to this Section is specified, furnish and install a mortise lock cylinder keyed to the building keying system.

B. Electrically Operated Locks: Fail secure unless otherwise indicated.

C. Lock Cylinders: Manufacturer's standard tumbler type, six-pin standard core.
   1. Provide cams and/or tailpieces as required for locking devices required.

D. Keying: Grand master keyed.
   1. Include construction keying.
   2. Key to existing keying system.
   3. Supply keys in the following quantities:
      a. Five (5) master keys.
      b. Four (4) grand master keys.
      c. Ten (10) construction keys.
      d. Ten (10) control keys and two (2) extra cylinder cores.
      e. Three (3) change keys for each lock.
   4. When providing keying information, comply with DHI Handbook "Keying systems and nomenclature".

2.04 HINGES

A. Hinges: Provide hinges on every swinging door.
   1. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
   2. Provide ball-bearing hinges at all doors having closers.
   3. Provide hinges in the quantities indicated.
   4. Provide non-removable pins on exterior outswinging doors.
   5. Where electrified hardware is mounted in door leaf, provide power transfer hinges.
B. Butt Hinges: Comply with BHMA A156.1 and A156.7; heavy weight, unless otherwise indicated.

C. Quantity of Hinges Per Door:
   1. Doors up to 60 inches High: Two hinges.
   2. Doors From 60 inches High up to 90 inches High: Three hinges.
   3. Doors 90 inches High up to 120 inches High: Four hinges.
   4. Doors over 120 inches High: One additional hinge per each additional 30 inches in height.

D. Manufacturers - Hinges:
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.05 PIVOTS

A. Pivots: Comply with BHMA A156.17.

B. Grade 1, certified. Space intermediate pivots equally not less than 25 inches on center apart or not more than 35 inches on center for doors over 121 inches high. Pivot hinges to have oil impregnated bronze bearing in the top pivot and a radial roller and thrust bearing in the bottom pivot with the bottom pivot designed to carry the full weight of the door. Pivots to be UL listed for windstorm where applicable.

C. Manufacturers - Pivots:
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.06 CYLINDRICAL LOCKSETS

A. Locking Functions: As defined in BHMA A156.2, Series 4000, Grade 1 certified. Furnish with solid cast levers, standard 2 3/4" backset and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.

B. Locks are to be non-handed and fully field reversible.

C. Functions are as follows:
   1. Office: F82 Grade 1, key not required to lock, unlocks upon exit.
   2. Always-Locked: F86, key required to lock, may not be left unlocked.

D. Manufacturers - Cylindrical Locksets:
   2. Substitutions: Not permitted.

2.07 MORTISE LOCKSETS

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

B. Locking Functions: As defined in BHMA A156.13, and as follows:
   1. Office: F04, key not required to lock, remains locked upon exit.

C. Manufacturers - Mortise Locksets:
   2. Substitutions: Not permitted.

2.08 FLUSHBOLTS AND COORDINATORS

A. Flushbolts: Lever extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
   1. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
   2. Floor Bolts: Provide dustproof strike except at metal thresholds.

B. Manual Flushbolts: Provide lever extensions for top bolt at over-size doors.
C. Coordinators: Provide on doors having closers and self-latching or automatic flushbolts to ensure that leaves close in proper order.

D. Manufacturers - Flushbolts:

2.09 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
   2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
   3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
   4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:
   2. Strikes for Bored Locks and Latches: BHMA A156.2.
   3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
   4. Dustproof Strikes: BHMA A156.16.

2.10 ELECTRIC STRIKES

A. Standard Electric Strikes: Heavy duty, cylindrical and mortise lock electric strikes conforming to ANSI/BHMA A156.31, Grade 1, UL listed for both Burglary Resistance and for use on fire rated door assemblies. Stainless steel construction with dual interlocking plunger design tested to exceed 3000 lbs. of static strength and 350 ft-lbs. of dynamic strength. Strikes tested for a minimum 1 million operating cycles. Provide strikes with 12 or 24 VDC capability and supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike.

B. Manufacturers - Electric Strikes:
   1. Folger Adam EDC (FO):www.southernfolger.com
   2. HES (HS): www.hesinnovations.com
   3. Substitutions: See Section 01 6000 - Product Requirements

2.11 POWER TRANSFER DEVICES

A. Electricified Quick Connect Transfer Hinges:
   1. Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets.
   2. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies.
   3. Wire nut connections are not acceptable.

B. Manufacturers - Electricified Quick Connect Transfer Hinges:
   2. Hager Companies (HA) - ETW-QC (# wires) Option.
   4. Stanley Hardware (ST) – C Option.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.12 EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
   a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
   b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

6. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.


9. Rail Sizing: Provide exit device rails factory sized for proper door width application.

10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

   1. Acceptable Manufacturers:
      a. Von Duprin (VD) - 35A/98 XP Series.
      b. Substitutions: Not permitted.

2.13 CLOSERS

A. Closers: Complying with BHMA A156.4.

   1. Provide surface-mounted, door-mounted closers unless otherwise indicated.
   2. Provide a door closer on every exterior door.
   3. Provide a door closer on every fire- and smoke-rated door. Spring hinges are not an acceptable self-closing device unless specifically so indicated.
   4. On pairs of swinging doors, if an overlapping astragal is present, provide coordinator to ensure the leaves close in proper order.
   5. At corridors, locate door-mounted closer on room side of door.
   6. At outswinging exterior doors, mount closer in inside of door.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard

C. Manufacturers - Surface Mounted Closers:

   2. LCN, an Allegion brand: www.allegion.com/us.
2.14 STOPS AND HOLDERS
A. Stops: Complying with BHMA A156.8; provide a stop for every swinging door, unless otherwise indicated.
   1. Provide wall stops, unless otherwise indicated.
   2. If wall stops are not practical, due to configuration of room or furnishings, provide overhead stop.
   3. Stop is not required if positive stop feature is specified for door closer; positive stop feature of door closer is not an acceptable substitute for a stop unless specifically so stated.

B. Manufacturers - Wall and Floor Stops/Holders:
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.15 GASKETING AND THRESHOLDS
A. Gaskets: Complying with BHMA A156.22.
   1. On each door in smoke partition, provide smoke gaskets; top, sides, and meeting stile of pairs. If fire/smoke partitions are not indicated on drawings, provide smoke gaskets on each door identified as a "smoke door" and 20-minute rated fire doors.
   2. On each exterior door, provide weatherstripping gaskets, unless otherwise indicated; top, sides, and meeting stiles of pairs.
      a. Where exterior door is also required to have fire or smoke rating, provide gaskets functioning as both smoke and weather seals.
   3. On each exterior door, provide door bottom sweep, unless otherwise indicated.
   4. On doors indicated as "sound-rated", "acoustical", or with an STC rating, provide sound-rated gaskets and automatic door bottom; make gaskets completely continuous, do not cut or notch gaskets for installation.

B. Thresholds: Complying with BHMA A156.21.
   1. At each exterior door, provide a threshold unless otherwise indicated.

C. Manufacturers - Gasketing and Thresholds:
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.16 PROTECTION PLATES AND ARCHITECTURAL TRIM
A. Protection Plates:
   1. Kickplate: Provide on push side of every door with closer, except aluminum storefront and glass entry doors.
   2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets

B. Manufacturers - Protection Plates and Architectural Trim:
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.17 ELECTRONIC ACCESSORIES
A. Request-to-Exit Motion Sensor: Request-to-Exit Sensors motion detectors specifically designed for detecting exiting through a door from the secure area to a non-secure area. Include built-in timers (up to 60 second adjustable timing), door monitor with sounder alert, internal vertical
pointability coverage, 12VDC or 24VDC power and selectable relay trigger with fail safe/fail
secure modes.
1. Acceptable Manufacturers:
   a. Securitron (SU) - XMS Series.
   b. Substitutions: See Section 01 6000 - Product Requirements.

B. Door Position Switches: Door position magnetic reed contact switches specifically designed for
use in commercial door applications. On recessed models the contact and magnetic housing
snap-lock into a 1” diameter hole. Surface mounted models include wide gap distance design
complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth
Magnet installation on steel doors with flush top channels.
1. Acceptable Manufacturers:
   a. Securitron (SU) - DPS Series.
   b. Substitutions: See Section 01 6000 - Product Requirements.

C. Hardwired Exit Alarms: Exit alarms are surface or flush mounted and operate with AC/DC
hardwired power with optional 9V battery backup. Provide 100 dB horn for security and field
selectable features for status indicators and automatic rearming options.
1. Acceptable Manufacturers:
   a. Detex Corporation (DX) - EAX-2500 Series.
   b. Substitutions: See Section 01 6000 - Product Requirements.

2.18 FIRE DEPARTMENT LOCK BOX
A. Fire Department Lock Box: Heavy-duty, surface mounted, solid stainless-steel box with hinged
door and interior gasket seal; single drill resistant lock with dust covers and tamper alarm.
   2. Finish: Manufacturer's standard dark bronze.

B. Manufacturers - Fire Department Lock Box:

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that doors and frames are ready to receive work; labeled, fire-rated doors and frames are
   present and properly installed, and dimensions are as indicated on shop drawings.

B. Verify that electric power is available to power operated devices and of the correct
   characteristics.

3.02 INSTALLATION
A. Install hardware in accordance with manufacturer’s instructions and applicable codes.

B. Use templates provided by hardware item manufacturer.

C. Do not install surface mounted items until finishes applied to substrate are complete.

D. Install hardware on fire-rated doors and frames in accordance with code and NFPA 80.

E. Mounting heights for hardware from finished floor to center line of hardware item.
   1. For steel doors and frames: Comply with DHI "Recommended Locations for Architectural
      Hardware for Steel Doors and Frames."

F. Set exterior door thresholds with full-width bead of elastomeric sealant on each point of contact
   with floor providing a continuous weather seal; anchor thresholds with stainless steel
countersunk screws.

3.03 FIELD QUALITY CONTROL
A. Field inspection and testing will be performed under provisions of Section 01 4000.

B. Provide an Architectural Hardware Consultant to inspect installation and certify that hardware
   and installation has been furnished and installed in accordance with manufacturer's instructions
   and as specified.
3.04 ADJUSTING
A. Adjust work under provisions of Section 01 7000.
B. Adjust hardware for smooth operation.
C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.05 CLEANING
A. Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.06 PROTECTION
A. Protect finished Work under provisions of Section 01 7000.
B. Do not permit adjacent work to damage hardware or finish.

3.07 SCHEDULE - ATTACHED

HARDWARE SETS

4.01 HARDWARE SCHEDULE

A. H1 - Doors: 108B, 109C, 204C
1. HINGE (HEAVY WEIGHT) T4A3386 X NRP 4-1/2" X 4-1/2" US 10 MK
2. ELECTRIC Hinge (HEAVY WEIGHT) T4A3386-CC8 4-1/2" X 4-1/2" US10 MK
3. DELAYED EGRESS RIM EXIT DEVICE CX 99EO SNB US10 VD
4. CYLINDER 1E-74 612 BE
5. DOOR CLOSER CPS7500 SNB 691 NO
6. Kick Plate K1050 10" H x 2" LDW 4BE CSK US10 RO
7. Threshold 273x3DFG x LAR PE
8. Gasketing 2891DS @ head PE
9. Gasketing 290DS @ jambs PE
10. Door Bottom 216BDGFG x DW PE
11. Power Supply PS902 (for delayed egress) VD
12. Notes: Door is normally closed and locked. No exterior access, exit only. Emergency delayed egress by pushing exit device rail, which initiates an irreversible alarm and 15-30 second delay before door is unlocked. Delayed egress exit device is tied to the fire alarm system and releases upon loss of power. Exit device is manually reset at door with cylinder in rail.

B. H2 - Door: 111B
1. Hinge (heavy weight) T4A3386 x NRP 4-1/2" x 4-1/2" US10 MK
2. Electric Hinge (heavy weight) T4A3386-CC8 4-1/2" x 4-1/2" US10 MK
3. Delayed Egress Rim Exit Device CX 99L E 996L(Std) SNB US10 VD
4. Cylinder 1E-74 612 BE
5. Door Closer CPS7500 SNB 691 NO
6. Kick Plate K1050 10" H x 2" LDW 4BE CSK US10 RO
7. Threshold 273x3DFG x LAR PE
8. Gasketing 2891DS @ head PE
9. Gasketing 290DS @ jambs PE
10. Door Bottom 216BDGFG x DW PE
11. Card Reader By security contractor
12. Low Voltage Power - Door Panel By security contractor
13. Power Supply PS902 (for delayed egress) VD
14. Notes: Door is normally closed and locked. Exterior access by presenting valid credential to card reader unlocking electrified lever trim. Emergency delayed egress by pushing exit device rail, which initiates an irreversible alarm and 15-30 second delay before door is unlocked. Delayed egress exit device is tied to the fire alarm system and releases upon loss of power. Exit device is manually reset at door with cylinder in rail.
### C. H3 - Doors: 109B, 204B

1. Hinge TA2714 4-1/2" x 4-1/2" (NRP) US10 MK
2. Electric Hinge TA2714-QC8 4-1/2" x 4-1/2" US10 MK
3. Electrified Cylindrical Lock 9KW37DEU 15D S3 612 BE
4. Cylinder Permanent Core 612 BE
5. Door Closer (hold open) (P) 7500H SNB 691 NO
6. Kick Plate K1050 10" H x 2" LDW 4BE CSK US10 RO
7. Wall Stop 403 US10 RO
8. Threshold 2008DPK x LAR PE
9. ADB Corner Pad ACP112BL/2 PE
10. Gasketing S773BL @ head and jambs PE
11. Gasketing S44BL @ head and jambs PE
12. Door Bottom PDB411AE x DW PE
13. Card Reader By security contractor
14. Low Voltage Power - Door Panel By security contractor
15. Exit Alarm EAX-2500S/F/SK IC7 Black DE
16. Notes: Door is normally closed and locked. Authorized access by presenting valid credential to card reader unlocking electrified lever lock. Authorized non-alarmed egress by presenting valid credential to card reader on inside of door, temporarily inhibiting the alarm for egress. Free alarmed egress at all times.

### D. H4 - Doors: 111A, 113B

1. Hinge TA2714 4-1/2" x 4-1/2" (NRP) US10 MK
2. Electric Hinge TA2714-QC8 4-1/2" x 4-1/2" US10 MK
3. Electrified Cylindrical Lock 9KW37DEU 15D S3 612 BE
4. Cylinder Permanent Core 612 BE
5. Door Closer (P) 7500 SNB 691 NO
6. Kick Plate K1050 10" H x 2" LDW 4BE CSK US10 RO
7. Wall Stop 403 US10 RO
8. Threshold 2008DPK x LAR PE
9. ADB Corner Pad ACP112BL/2 PE
10. Gasketing S773BL @ head and jambs PE
11. Gasketing S44BL @ head and jambs PE
12. Door Bottom PDB411AE 36" PE
13. Card Reader By security contractor
14. Low Voltage Power - Door Panel By security contractor
15. Exit Alarm EAX-2500S/F/SK IC7 Black DE
16. Notes: Door is normally closed and locked. Authorized access by presenting valid credential to card reader unlocking electrified lever lock. Authorized non-alarmed egress by presenting valid credential to card reader on inside of door, temporarily inhibiting the alarm for egress. Free alarmed egress at all times.

### E. H5 - Door: 200A

1. Pivot Set 195 612 RF
2. Intermediate Pivot M19 612 RF
3. Electric Intermediate Pivot EM19 612 RF
5. Dust Proof Strike 570 US10 RO
6. Utility Lock 70 8231 LNL US10 SA
7. Cylinder Permanent Core 612 BE
8. Electric Strike 1006 612 HS
9. Electric Strike Faceplate KM 612 HS
10. Door Closer (hold open) PR7500H SNB 691 NO
11. Kick Plate K1050 10" H x 2" LDW 4BE CSK US10 RO
12. Door Stop w/Holder 464 US26D RO
13. Gasketing S44D @ head and jambs  PE
14. Meeting Stile Seal 305CN  PE
15. Low Voltage Power - Door Panel by security contractor
16. Keypad by security contractor
17. Door Position Switch DPS-M-BK  SU
18. Motion Sensor (REX) XMS  SU
19. Notes: Doors are normally closed and locked. No access from the pull side. Authorized entry from the push side by entering a correct PIN at keypad, which unlocks electric strike. Lock is one-sided, single cylinder, and locked all the time on the push side.

F. H6 - Doors: 114, 205, 206
   1. Hinge (heavy weight) T4A3786 NRP 5" x 4-1/2" US10 MK
   2. Storeroom Lock 9K37D 15D S3 612 BE
   3. Door Closer (hold open) (P) 7500H SNB 691 NO
   4. Kick Plate K1050 10" H x 2" LDW 4BE CSK US10 RO
   5. Wall Stop 403 US10 RO
   6. Gasketing S44D @ head and jambs PE

G. H7 - Doors: 110, 201
   1. Hinge TA2714 4-1/2" x 4-1/2" (NRP) US10 MK
   2. Dust Proof Strike 570 US10 RO
   5. Door Closer (P) 7500 SNB 691 NO
   6. Kick Plate K1050 10" H x 2" LDW 4BE CSK US10 RO
   7. Wall Stop 403 US10 RO
   8. Gasketing S44D @ head and jambs PE
   9. Meeting Stile Seal 305CN PE

H. H8 - Doors: 103, 104, 105, 107
   1. Hinge TA2714 4-1/2" x 4-1/2" (NRP) US10 MK
   2. Office Lock 9K37AB 15D S3 612 BE
   3. Kick Plate K1050 10" H x 2" LDW 4BE CSK US10 RO
   4. Wall Stop 403 US10 RO
   5. Silencer 608 RO

I. H9 - Doors: 108A, 203
   1. Hinge TA2714 4-1/2" x 4-1/2" US10 MK
   2. Passage Set 9K30N 15D S3 612 BE
   3. Door Closer (P) 7500 SNB 691 NO
   4. Kick Plate K1050 10" H x 2" LDW 4BE CSK US10 RO
   5. Wall Stop 403 US10 RO
   6. Threshold 270D x LAR PE
   7. Gasketing S44D @ head and jambs PE
   8. Sweep 315DN x DW PE

J. H10 - Doors: 111C
   1. Hinge TA2714 4-1/2" x 4-1/2" US10 MK
   2. Passage Set 9K30N 15D S3 612 BE
   3. Door Closer (P) 7500 SNB 691 NO
   4. Kick Plate K1050 10" H x 2" LDW 4BE CSK US10 RO
   5. Wall Stop 403 US10 RO
   6. Gasketing S44D @ head and jambs PE
   7. Notes: Verify existing door and frame conditions to receive new hardware.

K. H11 - Doors: 109A, 113A, 204A
   1. Hardware See Div 8 Specification Section
2. Notes: Overhead sectional door with electric operation - seals - security sensor - safety mechanism - keypad by security.

L. **H12 - Doors: 112A, 112C, 207**
   1. Hardware See Div 8 Specification Section
   2. Notes: Coiling shutter with electric operation.

M. **H13 - Doors: 101, 112B**
   1. Hardware See Div 8 Specification Section
   2. Notes: Coiling shutter with electric operation - 3 hour fire rating - activated by fire alarm system - security sensor - keypad by security.

N. **H14 - Door: 200B**
   1. Hardware See Div 8 Specification Section
   2. Notes: Coiling shutter with electric operation - 3 hour fire rating - activated by fire alarm system.

**END OF SECTION**
SECTION 08 8000
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Insulating glass units.
B. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS
A. Section 08 1113 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
B. Section 08 4313 - Aluminum-Framed Storefronts: Glazing furnished as part of storefront assembly.
C. Section 08 5113 - ALUMINUM WINDOWS: Glazing furnished by window manufacturer.

1.03 REFERENCE STANDARDS
L. GANA (SM) - GANA Sealant Manual; Glass Association of North America; 2008.
N. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2014.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
C. Samples: Submit two samples 12 by 12 inch in size of glass units.

D. Manufacturer's Certificate: Certify that glass and glazing products meets or exceeds specified requirements.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Insulating Glass Units: One of each glass size and each glass type.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.07 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Select type and thickness of exterior glazing assemblies to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Seismic Loads: Design and size glazing components to withstand seismic loads and sway displacement in accordance with the requirements of ASCE 7.
   4. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   5. Glass thicknesses listed are minimum.

B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
   1. In conjunction with vapor retarder and joint sealer materials described in other sections.
      a. Refer to Section 07 2500.
   2. To utilize the inner pane of multiple pane insulating glass units for the continuity of the vapor retarder and air barrier seal.
   3. To maintain a continuous vapor retarder and air barrier throughout the glazed assembly from glass pane to heel bead of glazing sealant.

C. Thermal and Optical Performance: Provide glass products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 5.2/6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 5.2/6.3 computer program.

2.02 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless noted otherwise.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality-Q3.
   2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and FT.
4. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality-Q3, color and performance characteristics as indicated.
5. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

2.03 INSULATING GLASS UNITS
A. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   5. Edge Seal:
      a. Dual-Sealed System: Provide polysisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
      b. Color: Black.
   6. Purge interpane space with dry air, hermetically sealed.
B. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.
   1. Applications: Exterior glazing unless otherwise indicated.
   2. Space between lites filled with argon.
   3. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
      a. Tint: Gray.
      b. Coating: Low-E (solar control type), on #2 surface.
   4. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
      a. Tint: Clear.
   5. Total Thickness: 1 inch.
   6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.33, nominal.

2.04 GLAZING UNITS
A. Type G-1 - Monolithic Interior Vision Glazing:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Fully tempered float glass.
   3. Tint: Clear.
   4. Thickness: 1/4 inch, nominal.
   5. Glazing Method: Dry glazing method, gasket glazing.
B. Type G-2 - Fire-Protection-Rated Glazing: Type, thickness, and configuration as required to achieve indicated ratings.
   1. Applications:
      a. Glazed lites in fire doors.
      b. Glass Type: Fully tempered float glass.
   3. Labeling: Provide permanent label on fire-rated glazing in compliance with ICC (IBC) and authorities having jurisdiction.
   4. Provide products listed by Underwriters Laboratories or Intertek Warnock Hersey.
   5. Safety Glazing Certification: 16 CFR 1201 Category II.
   7. Fire-Protection-Rating Period: As indicated on drawings.
C. Type G-3 - Monolithic Safety Glazing: Non-fire-rated.
   1. Applications:
      a. Glazed lites in doors, except fire doors.
      b. Glazed sidelights to doors, except in fire-rated walls and partitions.
      c. Other locations required by applicable federal, state, and local codes and regulations.
d. Other locations indicated on the drawings.
2. Glass Type: Fully tempered safety glass as specified.
3. Tint: Clear.
4. Thickness: 1/4 inch, nominal.
5. Glazing Method: Dry glazing method, gasket glazing.

2.05 GLAZING COMPOUNDS
A. Type GC-3 - Polysulfide Sealant: Two component; chemical curing, non-sagging type; ASTM C920, Type M, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

2.06 ACCESSORIES
A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Continuous x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
   1. Width: As required for application.
   2. Thickness: As required for application.
D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
E. Glazing Clips: Manufacturer's standard type.

2.07 SOURCE QUALITY CONTROL
A. See Section 01 4000 - Quality Requirements, for additional requirements.

PART 3 EXECUTION
3.01 VERIFICATION OF CONDITIONS
A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
B. Verify that the minimum required face and edge clearances are being provided.
C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
D. Verify that sealing between joints of glass framing members has been completed effectively.
E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION
A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL
A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
B. Install glazing sealants in accordance with ASTM C1193, GANA Sealant Manual, and manufacturer’s instructions.
C. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
D. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

**3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)**
A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

**3.05 FIELD QUALITY CONTROL**
A. See Section 01 4000 - Quality Requirements, for additional requirements.
B. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
C. Monitor and report installation procedures and unacceptable conditions.

**3.06 CLEANING**
A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.
B. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
C. Remove non-permanent labels immediately after glazing installation is complete.
D. Clean glass and adjacent surfaces after sealants are fully cured.
E. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer’s written recommendations.

**3.07 PROTECTION**
A. After installation, mark pane with an ‘X’ by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION
SECTION 09 2116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Performance criteria for gypsum board assemblies.
B. Metal stud wall framing.
C. Metal channel ceiling framing.
D. Acoustic insulation.
E. Gypsum wallboard.
F. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS
A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.
B. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS
A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
G. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
N. ASTM E413 - Classification for Rating Sound Insulation; 2010.
O. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2013.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.05 QUALITY ASSURANCE
A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES
A. Provide completed assemblies complying with ASTM C840 and GA-216.
B. Interior Partitions: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
C. Fire Rated Assemblies: Provide completed assemblies with the following characteristics:
   2. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.

2.02 METAL FRAMING MATERIALS
A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
   1. Studs: “C” shaped with flat or formed webs with knurled faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C-shaped.
   5. Resilient Furring Channels: 1/2 inch depth, for attachment to substrate through one leg only.
B. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
C. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI SG02-1.
   3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
   4. Deflection and Firestop Track: a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.

2.03 BOARD MATERIALS
A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces, unless otherwise indicated.
   2. Glass mat faced gypsum panels as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
   3. Unfaced fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
   4. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
5. Thickness:

2.04 ACCESSORIES
   A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3 inch.
   B. Joint Accessories and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
      1. Expansion Joints: V-shaped PVC with tear away fins.
   C. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
      1. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
   D. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION
   A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
   B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
      1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.

3.03 FRAMING INSTALLATION
   A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
   B. Studs: Space studs at 16 inches on center.
      1. Extend partition framing to structure where indicated and to ceiling in other locations.
      2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
      3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
   C. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
   D. Standard Wall Furring: Install at ICF walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
      1. Orientation: Horizontal.
      2. Spacing: As indicated.
   E. Blocking: Install wood blocking for support of:
      1. Wall mounted cabinets.

3.04 ACOUSTIC ACCESSORIES INSTALLATION
   A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
3.05 BOARD INSTALLATION
A. Comply with ASTM C 840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

3.06 INSTALLATION OF TRIM AND ACCESSORIES
A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
B. Corner Beads: Install at external corners, using longest practical lengths.

3.07 JOINT TREATMENT
B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.
   2. Taping, filling, and sanding is not required at surfaces behind fixed cabinetry.
   3. Taping, filling and sanding is not required at base layer of double layer applications.
D. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.08 TOLERANCES
A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION
SECTION 09 5100
SUSPENDED ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Suspended metal grid ceiling system.
B. Acoustical units.

1.02 RELATED REQUIREMENTS
A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS
D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on suspension system components.
C. Samples: Submit two samples 6 by 6 inch in size illustrating material and finish of acoustical units.
D. Manufacturer's Installation Instructions: Indicate special procedures.
E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.06 QUALITY ASSURANCE
A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 FIELD CONDITIONS
A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS
A. Acoustical Units - General: ASTM E1264, Class A.
B. Acoustical Tile Type 1: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
   1. VOC Content: As specified in Section 01 6116.
   2. Size: 24 by 24 inches.
5. Edge: Square.
7. Surface Pattern: Non-directional fissured.

2.02 SUSPENSION SYSTEM(S)
A. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
B. Exposed Steel Suspension System Type 1: Formed steel, commercial quality cold rolled; heavy-duty.
   1. Profile: Tee; 15/16 inch wide face.
   2. Construction: Double web.

2.03 ACCESSORIES
A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
B. Perimeter Moldings: Same material and finish as grid.
   1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
C. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify existing conditions before starting work.
B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM
A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
C. Locate system on room axis according to reflected plan.
D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
E. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.
F. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
J. Do not eccentrically load system or induce rotation of runners.
K. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Overlap and rivet corners.
3.03 INSTALLATION - ACOUSTICAL UNITS
   A. Install acoustical units in accordance with manufacturer’s instructions.
   B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
   C. Fit border trim neatly against abutting surfaces.
   D. Install units after above-ceiling work is complete.
   E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
   F. Cutting Acoustical Units:
      1. Make field cut edges of same profile as factory edges.

3.04 TOLERANCES
   A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
   B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION
SECTION 09 6500
RESILIENT FLOORING

PART 1  GENERAL

1.01  SECTION INCLUDES
A. Resilient base.
B. Resilient stair accessories.
C. Installation accessories.

1.02  RELATED REQUIREMENTS
A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

1.03  REFERENCE STANDARDS

1.04  SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
D. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Wall Base: 12 linear feet of each type and color.

1.05  DELIVERY, STORAGE, AND HANDLING
A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
B. Store all materials off of the floor in an acclimatized, weather-tight space.
C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
D. Protect roll materials from damage by storing on end.
E. Do not double stack pallets.

1.06  FIELD CONDITIONS
A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2  PRODUCTS

2.01  STAIR COVERING
A. Stair Treads: Rubber; full width and depth of stair tread in one piece; tapered thickness; nosing not less than 1-5/8 inch deep.
   1. Manufacturers:
RESILIENT FLOORING

2.02 RESILIENT BASE
A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
   1. Height: 4 inch.
   2. Thickness: 0.125 inch thick.
   4. Length: Roll.
   5. Color: Color as selected from manufacturer's standards.
   6. Accessories: Premolded external corners and end stops.
   7. Manufacturers:
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.03 ACCESSORIES
A. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.
   1. VOC Content Limits: As specified in Section 01 6116.
B. Moldings, Transition and Edge Strips: Same material as flooring.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

3.02 PREPARATION
A. Clean substrate.

3.03 RESILIENT BASE
A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
C. Install base on solid backing. Bond tightly to wall and floor surfaces.
D. Scribe and fit to door frames and other interruptions.

3.04 STAIR COVERINGS
A. Adhere over entire surface. Fit accurately and securely.
3.05 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.
B. Clean in accordance with manufacturer's instructions.

END OF SECTION
SECTION 09 6813
TILE CARPETING

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Carpet tile, fully adhered.

1.02 RELATED REQUIREMENTS
   A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   B. Section 01 7419 - Construction Waste Management and Disposal: Reclamation/Recycling of new carpet tile scrap.
   C. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

1.03 REFERENCE STANDARDS
   B. CRI 104 - Standard for Installation of Commercial Carpet; Carpet and Rug Institute; 2015.
   C. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute; 2011.
   D. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Carpet and Rug Institute; Current Edition.

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
   C. Samples: Submit four carpet tiles illustrating color and pattern design for each carpet color selected.
   D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
   E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
      1. See Section 01 6000 - Product Requirements, for additional provisions.
      2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.05 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
   B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.06 FIELD CONDITIONS
   A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS
2.01 MANUFACTURERS
   A. Tile Carpeting:
      4. Substitutions: See Section 01 6000 - Product Requirements.
2.02 MATERIALS
   A. Tile Carpeting, Type CPT-1: Tufted, manufactured in one color dye lot.
      1. Thickness: Min. 0.134 inch.
      2. Color: Color as selected from manufacturer's standards.
      3. Pattern: Pattern as selected from manufacturer's standards.
      4. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
      5. VOC Content: Comply with Section 01 6116.
      6. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
      7. Gage: Min. 5/64 inch.
      8. Stitches: Min. 10 per inch.
      9. Pile Weight: Min. 21 oz/sq yd.

2.03 ACCESSORIES
   A. Edge Strips: Embossed aluminum, color as selected by Architect.
   B. Adhesives:
      1. Compatible with materials being adhered; maximum VOC content as specified in Section 01 6116.
   C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
   B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet tile.
   C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
   D. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.
      1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
   E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION
   A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
   B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
   C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
   D. Vacuum clean substrate.

3.03 INSTALLATION
   A. Starting installation constitutes acceptance of sub-floor conditions.
   B. Install carpet tile in accordance with manufacturer's instructions.
   C. Blend carpet from different cartons to ensure minimal variation in color match.
   D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
   E. Lay carpet tile in square pattern, with pile direction alternating to next unit, set parallel to building lines.
   F. Fully adhere carpet tile to substrate.
   G. Trim carpet tile neatly at walls and around interruptions.
H. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
B. Clean and vacuum carpet surfaces.

END OF SECTION
PART 1 GENERAL
1.01 SECTION INCLUDES
A. Surface preparation.
B. Field application of paints.
C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Exposed surfaces of steel lintels and ledge angles.
D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Non-metallic roofing and flashing.
   7. Floors, unless specifically indicated.
   8. Glass.
   9. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS
A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 DEFINITIONS
A. Conform to ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS
B. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2012).
E. SSPC-SP 1 - Solvent Cleaning; 2015.
F. SSPC-SP 6 - Commercial Blast Cleaning; Society for Protective Coatings; 2007.
G. SSPC-SP 13 - Surface Preparation of Concrete; Society for Protective Coatings; 2003 (Reaffirmed 2015).

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   4. Manufacturer's installation instructions.
5. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.

C. Samples: Submit two paper chip samples, 2 by 4 inch in size illustrating range of colors available for each surface finishing product scheduled.

D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

E. Manufacturer's Instructions: Indicate special surface preparation procedures.

F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 4 gallons of each color; from the same product run, store where directed.
   3. Label each container with color in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience and approved by manufacturer.

1.07 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.

B. Locate where directed by Architect.

C. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
   1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
3. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.

B. Paints:

C. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL
A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
5. Supply each paint material in quantity required to complete entire project's work from a single production run.
6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content: Comply with Section 01 6116.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

E. Colors: As indicated in Color Schedule.
1. Allow for minimum of two colors for each system, unless otherwise indicated, without additional cost to Owner.
2. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.03 PAINT SYSTEMS - EXTERIOR
1. Two top coats and one coat primer.
2. Top Coat(s): Exterior Light Industrial Coating, Water Based; MPI #161, 163, or 164.
3. Top Coat Sheen:
   a. Satin: MPI gloss level 4; use this sheen at all locations.

B. Paint ME-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.

2.04 PRIMERS
A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
1. Rust-Inhibitive Water Based Primer; MPI #107.
2.05 ACCESSORY MATERIALS
   A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
   B. Patching Material: Latex filler.
   C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Do not begin application of paints and finishes until substrates have been properly prepared.
   B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
   C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
   D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
   E. Test shop-applied primer for compatibility with subsequent cover materials.
   F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
      1. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
      2. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION
   A. Clean surfaces thoroughly and correct defects prior to application.
   B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
   C. Remove or repair existing paints or finishes that exhibit surface defects.
   D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
   E. Seal surfaces that might cause bleed through or staining of topcoat.
   F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
   G. Concrete:
      1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
      2. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches. Allow to dry.
      3. Clean concrete according to ASTM D4258. Allow to dry.
      4. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
   H. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
   I. Ferrous Metal:
      1. Solvent clean according to SSPC-SP1.
      3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning”. Protect from corrosion until coated.
   J. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.
3.03 APPLICATION
A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
B. Apply products in accordance with manufacturer’s written instructions and recommendations in "MPI Architectural Painting Specification Manual".
C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
D. Apply each coat to uniform appearance.
E. Sand metal surfaces lightly between coats to achieve required finish.
F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL
A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.
B. Owner will provide field inspection.

3.05 CLEANING
A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION
A. Protect finishes until completion of project.
B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION
SECTION 09 9123
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Surface preparation.
B. Field application of paints.
C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Mechanical and Electrical:
      a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
      b. In finished areas, paint shop-primed items.
D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Floors, unless specifically indicated.
   7. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS
A. Section 01 3329 - Sustainable Design Reporting.
B. Section 01 3515 - LEED Certification Procedures.
C. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
D. Section 05 5000 - Metal Fabrications: Shop-primed items.
E. Section 09 9113 - Exterior Painting.

1.03 REFERENCE STANDARDS
D. SSPC-SP 1 - Solvent Cleaning; 2015.
E. SSPC-SP 6 - Commercial Blast Cleaning; Society for Protective Coatings; 2007.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
4. Manufacturer's installation instructions.
5. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.

C. Samples: Submit two paper chip samples, 2 by 4 inch in size illustrating range of colors and textures available for each surface finishing product scheduled.

D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
E. Manufacturer's Instructions: Indicate special surface preparation procedures.

F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 2 gallons of each color; from the same product run, store where directed.
   3. Label each container with color in addition to the manufacturer's label.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience and approved by manufacturer.

1.06 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.

B. Locate where directed by Architect.

C. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
3. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.

**B. Paints:**

**C. Substitutions:** See Section 01 6000 - Product Requirements.

### 2.02 PAINTS AND FINISHES - GENERAL

**A.** Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
4. Supply each paint material in quantity required to complete entire project's work from a single production run.
5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

**B.** Volatile Organic Compound (VOC) Content: Comply with Section 01 6116.

**C.** Flammability: Comply with applicable code for surface burning characteristics.

**D.** Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

**E.** Colors: As indicated on drawings.
1. Allow for minimum of two colors for each system, unless otherwise indicated, without additional cost to Owner.
2. Extend colors to surface edges; colors may change at any edge as directed by Architect.
3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.
4. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.

### 2.03 PAINT SYSTEMS - INTERIOR

**A.** Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, wood, uncoated steel, and shop primed steel.
1. Two top coats and one coat primer.
2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143, 144, 145, 146, 147, or 148.
3. Top Coat Sheen:
a. Satin: MPI gloss level 4; use this sheen at all locations.
4. Primer: As recommended by top coat manufacturer for specific substrate.

B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals:
   1. Medium duty applications include doors, door frames, railings, handrails, guardrails, and balustrades.
   2. Two top coats and one coat primer.
   3. Top Coat(s): Interior Light Industrial Coating, Water Based; MPI #153 or 154.
   4. Top Coat Sheen:
      a. Satin: MPI gloss level 4; use this sheen at all locations.
   5. Primer: As recommended by top coat manufacturer for specific substrate.

   1. Two top coats and one coat primer.
   2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143, 144, 145, 146, 147, or 148.
   3. Top Coat Sheen:
      a. Satin: MPI gloss level 4; use this sheen at all locations.

D. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, and metal fabrications.
   1. Shop primer by others.
   2. One top coat; white.
   3. Top Coat: Latex Dry Fall; MPI #118, 155, or 226.
   4. Top Coat Sheen:
      a. Eggshell: MPI gloss level 3; use this sheen at all locations.
   5. Primer: As recommended by top coat manufacturer for specific substrate.

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
   1. Interior Institutional Low Odor/VOC Primer Sealer; MPI #149.

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.
B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
E. Test shop-applied primer for compatibility with subsequent cover materials.
F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
   3. Concrete Floors and Traffic Surfaces: 8 percent.
3.02 PREPARATION
A. Clean surfaces thoroughly and correct defects prior to application.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Remove or repair existing paints or finishes that exhibit surface defects.
D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
E. Seal surfaces that might cause bleed through or staining of topcoat.
F. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
H. Ferrous Metal:
   1. Solvent clean according to SSPC-SP1.
   3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
I. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
J. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION
A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
G. Sand wood and metal surfaces lightly between coats to achieve required finish.
H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL
A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.

3.05 CLEANING
A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION
A. Protect finishes until completion of project.
B. Touch-up damaged finishes after Substantial Completion.

3.07 SCHEDULE - PAINT SYSTEMS

A. Gypsum Board: Finish surfaces exposed to view.

B. Steel Doors and Frames: Finish surfaces exposed to view; MI-OP-3A, gloss.

C. Steel Fabrications: Finish surfaces exposed to view.

D. Shop-Primed Metal Items: Finish surfaces exposed to view.
   1. Finish the following items:
      a. Exposed surfaces of steel stairs and railings.
      2. Interior: MI-OP-2A.

END OF SECTION
SECTION 10 1400
SIGNAGE

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Room and door signs.

1.02 REFERENCE STANDARDS

1.03 FIELD CONDITIONS
A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS
2.01 SIGNAGE APPLICATIONS
A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
   1. Sign Type: Flat signs with engraved panel media as specified.
   2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
   3. Character Height: 1 inch.
   4. Sign Height: 6 inches, unless otherwise indicated.
   5. Office Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section for replaceable occupant name.
   6. Service Rooms: Identify with room names and numbers to be determined later, not those shown on the drawings.

2.02 SIGN TYPES
A. Flat Signs: Signage media without frame.
   1. Edges: Square.
   2. Corners: Square.
B. Color and Font: Unless otherwise indicated:
   1. Character Font: Helvetica, Arial, or other sans serif font.
   2. Character Case: Upper case only.

2.03 TACTILE SIGNAGE MEDIA
A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
   1. Total Thickness: 1/16 inch.

2.04 ACCESSORIES
A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install neatly, with horizontal edges level.

C. Locate signs where indicated:
   1. Room and Door Signs: Locate on wall at latch side of door with centerline of sign at 60 inches above finished floor.
   2. If no location is indicated obtain Owner's instructions.

D. Protect from damage until Substantial Completion; repair or replace damage items.

END OF SECTION
SECTION 10 2213  
WIRE MESH PARTITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Wire mesh system for walls.
B. Access door.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS
B. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

1.04 DESIGN REQUIREMENTS
A. Design partition system to provide for movement of components without damage, undue stress on fasteners or other detrimental effects, when subject to design loads.
B. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for screen materials, finishes.
C. Shop Drawings: Indicate plan and vertical dimensions, elevations, component details; head, jamb, and sill details; location of hardware. Provide component details, anchorage, and type and location of fasteners.
   1. Show field measurements on shop drawings.
D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.06 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Wire Mesh Partitions:
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 WIRE MESH PARTITIONS
A. Wire Mesh Partitions: Factory-fabricated modular assemblies of wall panels, doors, anchors, and accessories as required to provide a complete system and as indicated.
2.03 MATERIALS
A. Framing Members: ASTM A500/A500M, Grade B cold-formed steel tubing, square and rectangular shaped.
B. Woven Screen Wire: ASTM A510/A510M uncoated crimped steel wire; conforming to the following:
   1. Warp and Fill Wire Size: 10 gage, 0.1019 inch.
   2. Mesh Size: 1.5 by 1.5 inch.
C. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

2.04 FASTENERS
A. Bolts, Nuts and Washers: Hot dip galvanized.
B. Anchorage Devices: Provide power driven, powder actuated, and drilled expansion bolts.
C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of structure.

2.05 ACCESSORIES
A. Bracing: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.
B. Plates, Gussets, Clips: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.
C. Floor and Ceiling Pilaster Shoe: Manufacturer's standard.
D. Floor Base: Manufacturer's standard.
E. Shop and Touch-Up Primer:
   1. Galvanized Surfaces: SSPC-Paint 20, Type II - Organic, complying with VOC limitations of authorities having jurisdiction.

2.06 HARDWARE
A. Hinges: 1-1/2 pair butt hinges riveted to both door and hinge bar.
B. Mortise locks: keyed outside, recessed knob inside.

2.07 COMPONENTS
A. Corner Posts: 1-1/4" by 1-1/4"
B. Intermediate Posts: 1-1/4" by 5/8"
C. Top Rail Horizontal Members: Corner Posts: 2-1/4" by 1" 
D. Cross Bracing: 1" x 1/2" cold rolled channels.

2.08 FABRICATION
A. Fit and assemble in largest practical sections for delivery to site, ready for installation.
B. Make exposed joints flush or tight.
C. Provide components required for anchorage to adjacent construction.
D. Frame openings made for penetrating mechanical and electrical components.
E. Fabricate door for hinged operation.

2.09 FINISHES
A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
B. Galvanizing: In accordance with requirements of ASTM A123/A123M.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that field measurements are as indicated.
B. Verify that substrate surfaces and required openings are ready to receive work.
3.02 PREPARATION
   A. Clean substrate surfaces.

3.03 INSTALLATION
   A. Install in accordance with manufacturer's instructions.
   B. Install items plumb and level, accurately fitted, free from distortion or defects.
   C. Perform field welding in accordance with AWS D1.1/D1.1M.
   D. After installation, touch-up field welds scratched or damaged surfaces with shop applied finish.

3.04 TOLERANCES
   A. Maximum Variation From Plumb or Level: 1/4 inch.
   B. Maximum Misalignment From True Position: 1/4 inch.

3.05 ADJUSTING
   A. Adjust hinged doors to achieve free movement.

3.06 CLEANING
   A. Remove temporary protection to prefinished surfaces.

END OF SECTION
SECTION 10 4400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Fire extinguishers.
   B. Fire extinguisher cabinets.
   C. Accessories.

1.02 RELATED REQUIREMENTS
   A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.05 FIELD CONDITIONS

PART 2 PRODUCTS

2.01 FIRE EXTINGUISHERS
   A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
      1. Provide extinguishers labeled by UL (DIR) for the purpose specified and indicated.
   B. Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gage.
      1. Cartridge Operated: Spun shell.
      2. Class: A:B:C.
      3. Size: 10 pound.
      4. Finish: Baked polyester powder coat, red color.
   C. FE-36 Type Fire Extinguishers: Stainless steel tank, with pressure gage.
      1. Class: A:B:C.
      2. Size: 10 pound.
      3. Size and classification as scheduled.
      4. Finish: Baked polyester powder coat, red color.
      5. Location: Collections Storage

2.02 FIRE EXTINGUISHER CABINETS
   A. Metal: Formed primed steel sheet; 0.036 inch thick base metal.
   B. Cabinet Configuration: Recessed type.
      1. Sized to accommodate accessories.
      2. Trim: Flat, 1 inch wide face.
   C. Door: 0.036 inch thick, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with two butt hinge. Provide nylon catch.
   D. Door Glazing: Plastic, clear, 1/8 inch thick acrylic. Set in resilient channel gasket glazing.
   E. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
   F. Weld, fill, and grind components smooth.
   G. Finish of Cabinet Exterior Trim and Door: Baked enamel, color as selected.
   H. Finish of Cabinet Interior: White enamel.
2.03 ACCESSORIES
   A. Extinguisher Brackets: Formed steel, chrome-plated.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify existing conditions before starting work.
   B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION
   A. Install in accordance with manufacturer's instructions.
   B. Install cabinets plumb and level in wall openings. Refer to drawings for locations and mounting heights.
   C. Secure rigidly in place.
   D. Place extinguishers and accessories in cabinets.

END OF SECTION
SECTION 11 1319.13
LOADING DOCK LEVELERS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Prefabricated steel leveler.
B. Operating hardware.
C. Mechanical restraint safety vehicle lock.

1.02 RELATED REQUIREMENTS
A. Section 03 1000 - Concrete Forming and Accessories: Placement of leveler frame and safety lock frame into concrete loading dock.
B. Section 03 3000 - Cast-in-Place Concrete: Concrete pit.

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide materials and finish, installation details, roughing-in measurements, and operation of unit and safety lock device.
C. Shop Drawings: Indicate required opening dimensions, tolerances of opening dimensions, placement dimensions of safety lock device, perimeter conditions of construction.
D. Manufacturer's Installation Instructions: Indicate special requirements.
E. Operation Data: Provide operating instructions, identify unit limitations.
F. Maintenance Data: Provide unit maintenance information, lubrication cycles, spare parts manual.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Dock Levelers:
   1. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COMPONENTS
A. Dock Leveler:
   4. Operating Range: 12 inches above dock level, 12 inches below dock level.
   5. Capacity: 25,000 lbs.
B. Vehicle Restraint: Mechanical lock, fabricated and welded steel plate construction, spring loaded to automatically latch when activated, to conform to ICC semitrailer vehicle bumper requirements for dimension and placement.
C. Deck: 1/4 inch steel checker plate deck, reinforced on underside, welded to fabricated steel frame; counter balanced with 16 inch long automatically operated plate lip; lip to lock in downward vertical position when leveler is at rest at dock level.
D. Pit Frame: Steel angle, 3 x 3 x 1/4 inch; welded corners, fitted with anchors for concrete embedment.

2.03 ACCESSORIES
A. Dock Bumpers: Two (2) standard.
2.04 FINISHES
   A. Leveler Platform: Factory enameled finish.
   B. Leveler Frame: Factory enameled finish.
   C. Pit Frame: Primed finish.
   D. Vehicle Restraint: Brown painted hook, galvanized steel operating mechanism.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that rough-in openings are acceptable.

3.02 INSTALLATION
   A. Install dock leveler and mechanical safety vehicle lock unit in prepared opening in accordance with manufacturer's instructions.
   B. Set square and level.
   C. Anchor unit securely, flush with dock. Weld back of leveling dock to pit frame. Touch-up weld with primer.
   D. Anchor safety lock securely and flush with vertical dock face.

3.03 ADJUSTING
   A. Adjust installed unit and safety device for smooth and balanced operation.

END OF SECTION
SECTION 14 4000
VERTICAL RECIPROCATING CONVEYOR

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Design, fabrication, and installation of vertical reciprocating conveyor (VRC) including drive unit, manual controls, gates, and enclosures as shown on project drawings and as specified herein.

1.02 RELATED SECTIONS
A. Section 03 3000: Cast-in-place concrete.
B. Sections of Division 26: Electrical as applicable.

1.03 REFERENCES
A. ANSI – American National Standards Institute (ANSI B20.1)
B. AWS - American Welding Society
C. NEMA – National Electrical Manufacturer’s Association

1.04 SUBMITTALS
B. Shop Drawings:
   1. Submit General Arrangement Drawing for approval within 3 weeks of receipt of an order, including plans, elevations, sections of the VRC, base plate and lateral load values, and recommended pit dimensions if applicable.
   2. Submit VRC Specification Sheet for approval within three weeks of receipt of an order, including scope of work, operating and control voltages, lift speed, type of paint, and any special project notes.
C. Closeout Submittals provided with equipment:
   1. Electrical Schematic Drawing including control panel layout and Bill of Materials reflecting original manufactured part numbers.
   3. Owner’s Manual including spare parts list, exploded parts drawings, operating instructions, maintenance schedule, service and troubleshooting guidelines.

1.05 QUALITY ASSURANCE
A. Manufacturer must have a minimum of five (5) years experience in the manufacture of vertical reciprocating conveyors.
B. All structural welding performed by manufacturers must be done by welders Certified to AWSD.1.1.1.
C. Manufacturer must guarantee compliance with ASME B20.1 Safety Standard for Conveyors and Related Equipment. Manufacturer further guarantees to repurchase the equipment at full purchase price in the event that Owner is unable to use the equipment due to lack of elevator code compliance.
D. Installer shall have the approval of the manufacturer and have a minimum of five (5) years experience in the installation of vertical reciprocating conveyors.

1.06 WARRANTY
A. The manufacturer shall warrant the VRC free of manufacturing defects beginning (30) days after shipment with the following minimums:
   1. One (1) year parts and labor.
   2. Purchased components – one (1) year parts, ninety (90) days labor.

PART 2 – PRODUCTS

2.01 MANUFACTURER
A. Basis of Design
1. Series F VRC manufactured by Pflow Industries, Inc., 6720 N. Teutonia Ave, Milwaukee, WI 53209
2. Phone (414) 352-9000 Fax (414) 352-9002 e-mail: pflow@pflow.com, www.pflow.com

B. Substitutions: Required prior approvals. See Section 01 6000 - Product Requirements.

2.02 VRC MECHANICAL SPECIFICATION

A. Capacity: The VRC shall be rated at a live load capacity of 10,000 lbs.
B. Speed: The VRC shall have a lifting speed of 15 to 20 feet per minute when loaded to capacity.
C. Vertical Travel: Per plans.
D. Lift Platform: The VRC platform shall have a minimum of 144 inches wide x 240 inches long x 120" load height with a steel deckplate and minimum 48" high welded handrails and kickplates on non-operating ends and safety chains with snap hooks on operating ends.
E. Support Columns: The VRC shall have a minimum of four (4) 6" wide support columns.
F. Deflection Under Load: When loaded to rated capacity, no portion of the VRC shall exhibit permanent deformations.
G. Lifting Means: Raising and lowering of the carriage shall be provided by chain over sprocket with common drive shaft connected to an efficient helical gear reducer assembly. The lifting chains shall be in a guidance assembly.
H. Safety Cams: Safety cams shall be mounted on the platform and connected directly to the lifting chains. The cams shall prevent the platform from falling more than 6" if tension is lost in the chains.
I. Safety Enclosure: Guarding on all non-operating sides of the VRC shall be by safety enclosures a minimum of 8'0" high consisting of material which will reject a ball 1/2" in diameter.
J. Floor Level Gates: Gates are required on all operating sides of the VRC at each level of operation.
1. Levels and gates are pre the drawings.
2. The gates shall be vertical acting type.
3. Each gate shall be equipped with an electro-mechanical interlock to prevent opening of the gate unless the carriage is present, and to prevent operation of the VRC unless all gates are closed.
K. Signs: “NO RIDER” signs shall be provided. Lettering shall be a minimum of 2” high for visibility.

2.03 VRC ELECTRICAL SPECIFICATION

A. Electric Motor:
1. Motor horsepower shall be sized for the rated live load and specified speed.
2. All motors are three phase and shall be designed for continuous duty at ambient temperatures from 32° to 102° Fahrenheit.
3. The motor shall not automatically restart when the overload device is reset.
4. The motor shall be equipped with a heavy-duty, fast-acting, fail-safe brake to ensure the brake will hold in case of power failure.
B. Controls:
1. Each operating floor level shall be equipped with a momentary contact push-button control station with call, send, and mushroom style E-stop operators for manual control of lift operation.
2. An internally pre-wired, NEMA 12 rated main control panel shall be provided with step-down transformer, reversing motor starter, overload relay, instantaneous current sensing jam relay, inrush bypass timer, field wiring terminal block, and positive acting brake contacts.
3. Travel Limit Switch: The VRC shall be equipped with a floor level, upper level, and overtravel limit switch to control positioning of the VRC platform.
6. Chain Tension Safety Device: Monitors each chain and shuts off motor while engaging brake in the event of a slack, taut, or broken chain.

7. Power Source: Owner shall terminate high voltage power within 10’ of the location designated for installation of the VRC.

**2.04 FINISHES**

A. All carbon steel surfaces shall be coated with an industrial enamel finish over primer – color, Blue.

B. Prior to painting, all dirt, mill scale, oil, and grease shall be removed from carbon steel surfaces by a combination of brushing, wiping, and use of solvents.

**PART 3 – EXECUTION**

**3.01 EXAMINATION**

A. Prior to commending installation of the VRC, the installer shall visually examine the conditions under which the VRC is to be installed and notify the architect in writing of conditions detrimental to the proper and time completion of the work.

**3.02 INSTALLATION**

A. Install the VRC, enclosures, and gates as indicated on the approved shop drawing.

B. Comply with manufacturer’s detailed installation instructions when installing the equipment.

**3.03 FIELD QUALITY CONTROL**

A. Inspection: Upon completion of installation, the VRC shall be inspected to verify that it meets all requirements of Parts 1, 2, and 3 of this Section.

B. Tests:

1. Operating Load Test: The owner will provide up to a 10,000 pound test load and load the VRC at the ground level. The loaded VRC platform shall be conveyed to an upper floor level and returned to the ground level to assure proper operation. If the VRC conveyor cannot lift or lower the load, the VRC shall fail the test.

2. Performance Test: This Test is to be performed in conjunction with Test 1 above. During the demonstration of the lifting and lowering test, the owner shall measure the time required to lift and lower the capacity load. The owner will average times for lifting and lowering the load and calculate the average lifting and lowering speed. If the VRC does not lift the load within 10% of the specified speed, or if the lowering speed exceeds the lifting speed by more than 10%, the VRC shall fail the test.

3. Stationary Load Test: This Test is to be performed in conjunction with Test 1 above. The loaded VRC platform remain stationary at an upper level for a minimum of one (1) hour. After the one (1) hour period, the VRC will be inspected for deflection of the components or drift of the platform. If deformation or downward drift is evident, the VRC shall fail the test.

**3.04 ADJUSTING AND CLEANUP**

A. Touch up all scratches, abrasions, and other defects in the per-finished surfaces with the same material color as that used in the factory-applied finish.

B. Remove and dispose of all rubbish and debris caused by the work under this section.

C. Verify that equipment is properly installed and guarded per ANSI/ASME B20.1.

**END OF SECTION**
SECTION 210517

SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Sleeve-seal systems.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.


E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.02 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
   3. Metraflex Company (The).
   4. Pipeline Seal and Insulator, Inc.
   5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

   1. Sealing Elements: EPDM-rubber or NBR 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.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.03 GROUT


B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

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.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.03 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
   a. Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade:
   a. Cast-iron wall sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   b. Galvanized-steel-pipe sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:
   a. PVC-pipe sleeves.

4. Interior Partitions:
   a. Galvanized-steel-pipe sleeves.

END OF SECTION 210517
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Escutcheons.
   2. Floor plates.

1.02 ACTION SUBMITTALS

B. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.02 FLOOR PLATES

D. One-Piece Floor Plates: Cast-iron flange.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:
   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
   c. Insulated Piping: One-piece, stamped-steel type.
   d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
   e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass finish.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. New Piping: One-piece, floor-plate type.

3.02 FIELD QUALITY CONTROL

E. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 210518
SECTION 21 0553
IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY
A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.

1.02 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS
A. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
   2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment’s Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS
A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
B. Letter Color: Red.

C. Background Color: Yellow.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

F. Fasteners: Stainless-steel rivets or self-tapping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.03 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; pipe size; and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 LABEL INSTALLATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install or permanently fasten labels on each major item of mechanical equipment.

D. Locate equipment labels where accessible and visible.
E. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

END OF SECTION 210553
SECTION 22 1313
WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Pipes, fittings, and specialties.
   2. Fire-protection valves.
   3. Fire-department connections.
   4. Sprinklers.
   5. Alarm devices.
   6. Pressure gages.

1.02 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.03 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a NICET Level III designer, using performance requirements and design criteria indicated.

   1. Available fire-hydrant flow test records indicate the following conditions:

      a. See drawings.

   C. FIRE-SUPPRESSION STANDPIPE DESIGN SHALL BE APPROVED BY AUTHORITIES HAVING JURISDICTION. PROVIDE APPROVAL LETTER FROM THE AUTHORITIES HAVING JURISDICTION TO THE ENGINEER PRIOR TO INSTALLATION.

   1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
   2. Sprinkler Occupancy Hazard Classifications (for areas not listed on the drawings, use the following):

      a. See drawings.
      b. Automobile Parking Areas: Ordinary Hazard, Group 1.
      c. Building Service Areas: Ordinary Hazard, Group 1.
      d. Churches: Light Hazard.
      e. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
      f. Dry Cleaners: Ordinary Hazard, Group 2.
      g. General Storage Areas: Ordinary Hazard, Group 1.
      h. Laundries: Ordinary Hazard, Group 1.
      i. Libraries except Stack Areas: Light Hazard.
j. Library Stack Areas: Ordinary Hazard, Group 2.
l. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
m. Office and Public Areas: Light Hazard.
n. Plastics Processing Areas: Extra Hazard, Group 2.
o. Printing Plants: Extra Hazard, Group 1.
q. Restaurant Service Areas: Ordinary Hazard, Group 1.
r. Solvent Cleaning Areas: Extra Hazard, Group 2.
s. Upholstering Plants: Extra Hazard, Group 1.

3. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Residential (Dwelling) Occupancy: 0.05 gpm over 400-sq. ft. area.
   b. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
   c. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
   d. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
   e. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
   f. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
   g. Special Occupancy Hazard: As determined by authorities having jurisdiction.

4. Maximum Protection Area per Sprinkler: Per UL listing.
5. Maximum Protection Area per Sprinkler:
   a. Residential Areas: 400 sq. ft.
   b. Office Spaces: 120 sq. ft.
   c. Storage Areas: 130 sq. ft.
   d. Mechanical Equipment Rooms: 130 sq. ft.
   e. Electrical Equipment Rooms: 130 sq. ft.
   f. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
   a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
   b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
   c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
D. Qualification Data: For qualified Installer.

E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

F. Welding certificates.

G. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

H. Field quality-control reports.

I. Operation and maintenance data.

1.05 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

   a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

   1. NFPA 13, "Installation of Sprinkler Systems."
   2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
   3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.02 STEEL PIPE AND FITTINGS

A. Standard Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
B. Schedule 30, Galvanized- and Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

C. Thinwall Galvanized- and Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

D. Schedule 5 Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, lightwall, with plain ends.


F. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.


H. Malleable- or Ductile-Iron Unions: UL 860.


J. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.


L. Grooved-Joint, Steel-Pipe Appurtenances:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      
      a. Anvil International, Inc.
      b. Corcoran Piping System Co.
      c. National Fittings, Inc.
      d. Shurjoint Piping Products.
      e. Tyco Fire & Building Products LP.
      f. Victaulic Company.

   2. Pressure Rating: 175 psig minimum.


   4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

M. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers’ pressure-seal tools.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      
      a. Victaulic Company.
      b. Anvil Company.
2.03 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.

B. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International, Inc.
   b. Clow Valve Company; a division of McWane, Inc.
   c. Crane Co.; Crane Valve Group.
   d. Fire-End & Croker Corporation.
   e. Fire Protection Products, Inc.
   g. Kennedy Valve; a division of McWane, Inc.
   h. Milwaukee Valve Company.
   i. Mueller Co.; Water Products Division.
   j. NIBCO INC.
   k. Potter Roemer.
   l. Reliable Automatic Sprinkler Co., Inc.
   m. Tyco Fire & Building Products LP.
   n. Victaulic Company.
   o. Watts Water Technologies, Inc.

4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

C. Bronze OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group
   b. Milwaukee Valve Company.
   c. NIBCO INC.
d. United Brass Works, Inc.

5. End Connections: Threaded.

D. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. American Valve, Inc.
   c. Clow Valve Company; a division of McWane, Inc.
   d. Crane Co.; Crane Valve Group; Crane Valves.
   e. Crane Co.; Crane Valve Group; Jenkins Valves.
   f. Crane Co.; Crane Valve Group; Stockham Division.
   g. Hammond Valve.
   h. Milwaukee Valve Company.
   i. Mueller Co.; Water Products Division.
   j. NIBCO INC.
   k. Tyco Fire & Building Products LP.
   l. United Brass Works, Inc.
   m. Watts Water Technologies, Inc.

4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International, Inc.
   b. Fivalco Inc.
   c. Global Safety Products, Inc.
   d. Kennedy Valve; a division of McWane, Inc.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Tyco Fire & Building Products LP.
   h. Victaulic Company.

2. Standard: UL 1091.
4. Valves NPS 2 and Smaller:
   a. Valve Type: Ball or butterfly.
   b. Body Material: Bronze.
   c. End Connections: Threaded.

5. Valves NPS 2-1/2 and Larger:
a. Valve Type: Butterfly.
b. Body Material: Cast or ductile iron.
c. End Connections: Flanged, grooved, or wafer.


2.05 TRIM AND DRAIN VALVES

A. General Requirements:


B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International, Inc.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Fire-End & Croker Corporation.
   d. Fire Protection Products, Inc.
   e. Kennedy Valve; a division of McWane, Inc.
   f. Milwaukee Valve Company.
   g. NIBCO INC.
   h. Potter Roemer.
   i. Red-White Valve Corporation.
   j. Tyco Fire & Building Products LP.
   k. Victaulic Company.
   l. Watts Water Technologies, Inc.

2.06 SPECIALTY VALVES

A. General Requirements:

3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AFAC Inc.
   c. Reliable Automatic Sprinkler Co., Inc.
   d. Tyco Fire & Building Products LP.
   e. Venus Fire Protection Ltd.
f. Victaulic Company.
g. Viking Corporation.

3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AFAC Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.

4. Type: Automatic draining, ball check.

2.07 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AFAC Inc.
   c. GMR International Equipment Corporation.
   d. Guardian Fire Equipment, Inc.
   e. Potter Roemer.

3. Type: Flush, for wall mounting.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
11. Number of Inlets: Two.
12. Escutcheon Plate Marking: Similar to "AUTO SPKR."
13. Finish: Rough brass or bronze.
15. Inlet size to match local fire department requirements.
2.08 SPRINKLER SPECIALTY PIPE FITTINGS

A. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. AGF Manufacturing Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.


4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.

5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

B. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. AGF Manufacturing Inc.
   b. Triple R Specialty.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
   e. Viking Corporation.


4. Body Material: Cast- or ductile-iron housing with sight glass.

5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

C. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. Fivalco Inc.
   b. FlexHead Industries, Inc.
   c. Gateway Tubing, Inc.


3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.


5. Size: Same as connected piping, for sprinkler.
2.09 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Reliable Automatic Sprinkler Co., Inc.
3. Tyco Fire & Building Products LP.
4. Victaulic Company.
5. Viking Corporation.

B. General Requirements:

4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

2. Nonresidential Applications: UL 199.
3. Residential Applications: UL 1626.
4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

E. Special Coatings:

1. Wax.
2. Lead.
3. Corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
2.010 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.

2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
5. Size: 10-inch diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
8. Outlet: NPS 1 drain connection.

C. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ADT Security Services, Inc.
   b. McDonnell & Miller; ITT Industries.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
   e. Viking Corporation.
   f. Watts Industries (Canada) Inc.

4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
7. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Fire-Lite Alarms, Inc.; a Honeywell company.
b. Kennedy Valve; a division of McWane, Inc.
c. Potter Electric Signal Company.
d. System Sensor; a Honeywell company.

3. Type: Electrically supervised.
5. Design: Signals that controlled valve is in other than fully open position.

E. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.

2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.011 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. AMETEK; U.S. Gauge Division.
   2. Ashcroft, Inc.
   4. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.01 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.
3.02 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 15 Section "Domestic Water Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.03 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
N. Fill sprinkler system piping with water.

O. Install sleeves for piping penetrations of walls, ceilings, and floors.

P. Install sleeve seals for piping penetrations of concrete walls and slabs.

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.04 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system’s pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

I. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
   1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

J. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

L. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
M. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.05 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
   1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

3.06 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

3.07 FLEX HOSE INSTALLATION

A. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.08 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.09 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.010 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.
3.011 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals.

3.012 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.
7. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.013 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.014 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. CPVC pipe; Schedule 40 CPVC fittings; and solvent-cemented joints may be used for light-hazard and residential occupancies AND WHERE APPROVED BY THE LOCAL AUTHORITY HAVING JURISDICTION.

D. Wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
4. Thinwall black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Thinwall black-steel pipe with plain ends; welding fittings; and welded joints.
6. Schedule 5 steel pipe; steel pressure-seal fittings; and pressure-sealed joints.

E. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 6, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Thinwall black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Thinwall black-steel pipe with plain ends; welding fittings; and welded joints.

3.015 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
4. Spaces Subject to Freezing: Sidewall, dry sprinklers or Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.
5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated Insert type.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313
SECTION 21 1316
DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinkler specialty pipe fittings.
5. Sprinklers.
6. Alarm devices.
7. Pressure gages.

1.02 SYSTEM DESCRIPTIONS

A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a NICET Level III designer, using performance requirements and design criteria indicated.

1. Available fire-hydrant flow test records indicate the following conditions:
   a. See drawings.

B. Sprinkler system design shall be approved by authorities having jurisdiction.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications (for areas not listed on the drawings, use the following):
   a. See drawings.
   b. Automobile Parking Areas: Ordinary Hazard, Group 1.
   c. Building Service Areas: Ordinary Hazard, Group 1.
   d. Churches: Light Hazard.
   e. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
   f. Dry Cleaners: Ordinary Hazard, Group 2.
   g. General Storage Areas: Ordinary Hazard, Group 1.
   h. Laundries: Ordinary Hazard, Group 1.
   i. Libraries except Stack Areas: Light Hazard.
   j. Library Stack Areas: Ordinary Hazard, Group 2.
I. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.

m. Office and Public Areas: Light Hazard.

n. Plastics Processing Areas: Extra Hazard, Group 2.

o. Printing Plants: Extra Hazard, Group 1.


q. Restaurant Service Areas: Ordinary Hazard, Group 1.

r. Solvent Cleaning Areas: Extra Hazard, Group 2.

s. Upholstering Plants: Extra Hazard, Group 1.

3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Residential (Dwelling) Occupancy: 0.05 gpm over 400-sq. ft. area.

b. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.

c. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.

d. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.

e. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.

f. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.

g. Special Occupancy Hazard: As determined by authorities having jurisdiction.

4. Maximum Protection Area per Sprinkler: Per UL listing.

5. Maximum Protection Area per Sprinkler:

a. Residential Areas: 400 sq. ft.

b. Office Spaces: 120 sq. ft.

c. Storage Areas: 130 sq. ft.

d. Mechanical Equipment Rooms: 130 sq. ft.

e. Electrical Equipment Rooms: 130 sq. ft.

f. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:

a. Light-Hazard Occupancies: 100 gpm for 30 minutes.

b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

C. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

D. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.07 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

   a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

   1. NFPA 13, "Installation of Sprinkler Systems."
   2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
   3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 STEEL PIPE AND FITTINGS

A. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 30, Galvanized-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
C. Thinwall Galvanized-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.


E. Galvanized, Steel Couplings: ASTM A 865, threaded.


G. Malleable- or Ductile-Iron Unions: UL 860.


I. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International, Inc.
   b. Shurjoint Piping Products.

J. Grooved-Joint, Steel-Pipe Appurtenances:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International, Inc.
   b. Corcoran Piping System Co.
   c. National Fittings, Inc.
   d. Shurjoint Piping Products.
   e. Tyco Fire & Building Products LP.
   f. Victaulic Company.

2. Pressure Rating: 250 psig minimum.


4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

### 2.03 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
2.04 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.

B. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International, Inc.
   b. Clow Valve Company; a division of McWane, Inc.
   c. Crane Co.; Crane Valve Group.
   d. Fire-End & Croker Corporation.
   e. Fire Protection Products, Inc.
   g. Kennedy Valve; a division of McWane, Inc.
   h. Milwaukee Valve Company.
   i. Mueller Co.; Water Products Division.
   j. NIBCO INC.
   k. Potter Roemer.
   l. Reliable Automatic Sprinkler Co., Inc.
   m. Tyco Fire & Building Products LP.
   n. Victaulic Company.
   o. Watts Water Technologies, Inc.

4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

C. Bronze OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group
   b. Milwaukee Valve Company.
   c. NIBCO INC.
   d. United Brass Works, Inc.

5. End Connections: Threaded.

D. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
b. American Valve, Inc.
c. Clow Valve Company; a division of McWane, Inc.
d. Crane Co.; Crane Valve Group; Crane Valves.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. Hammond Valve.
h. Milwaukee Valve Company.
i. Mueller Co.; Water Products Division.
j. NIBCO INC.
k. Tyco Fire & Building Products LP.
l. United Brass Works, Inc.
m. Watts Water Technologies, Inc.

4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International, Inc.
   b. Fivalco Inc.
   c. Global Safety Products, Inc.
   d. Kennedy Valve; a division of McWane, Inc.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Tyco Fire & Building Products LP.
   h. Victaulic Company.

2. Standard: UL 1091.
4. Valves NPS 2 and Smaller:
   a. Valve Type: Ball or butterfly.
   b. Body Material: Bronze.
   c. End Connections: Threaded.

5. Valves NPS 2-1/2 and Larger:
   a. Valve Type: Butterfly.
   b. Body Material: Cast or ductile iron.
   c. End Connections: Flanged, grooved, or wafer.


2.05 TRIM AND DRAIN VALVES

A. General Requirements:
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International, Inc.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Fire-End & Croker Corporation.
   d. Fire Protection Products, Inc.
   e. Kennedy Valve; a division of McWane, Inc.
   f. Milwaukee Valve Company.
   g. NIBCO INC.
   h. Potter Roemer.
   i. Red-White Valve Corporation.
   j. Tyco Fire & Building Products LP.
   k. Victaulic Company.
   l. Watts Water Technologies, Inc.

2.06 SPECIALTY VALVES

A. General Requirements:

3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AFAC Inc.
   c. Reliable Automatic Sprinkler Co., Inc.
   d. Tyco Fire & Building Products LP.
   e. Venus Fire Protection Ltd.
   f. Victaulic Company.
   g. Viking Corporation.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. AFAC Inc.
b. Reliable Automatic Sprinkler Co., Inc.
c. Tyco Fire & Building Products LP.

4. Type: Automatic draining, ball check.

D. Dry-Pipe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. AFAC Inc.
c. Reliable Automatic Sprinkler Co., Inc.
d. Tyco Fire & Building Products LP.
e. Venus Fire Protection Ltd.
f. Victaulic Company.
g. Viking Corporation.

2. Standard: UL 260
4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
5. Air Compressor:
   
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Gast Manufacturing Inc.
      2) General Air Products, Inc.
      3) Viking Corporation.

d. Power: 120-V ac, 60 Hz, single phase.

2.07 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AFAC Inc.
   c. GMR International Equipment Corporation.
   d. Guardian Fire Equipment, Inc.
   e. Potter Roemer.
3. Type: Flush, for wall mounting.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
11. Number of Inlets: Two.
12. Escutcheon Plate Marking: Similar to "AUTO SPKR."
13. Finish: Rough brass or bronze.
15. Inlet size to match local fire department requirements.

2.08 SPRINKLER SPECIALTY PIPE FITTINGS

A. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.

B. Branch Outlet Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. National Fittings, Inc.
      c. Shurjoint Piping Products.
      d. Tyco Fire & Building Products LP.
      e. Victaulic Company.

   5. Type: Mechanical-T and -cross fittings.
   6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
   7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
   8. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Flow Detection and Test Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AGF Manufacturing Inc.
      b. Reliable Automatic Sprinkler Co., Inc.
      c. Tyco Fire & Building Products LP.
      d. Victaulic Company.

   4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Branch Line Testers:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.
2. Standard: UL 199.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

E. Sprinkler Inspector's Test Fittings:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing Inc.
   b. Triple R Specialty.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
   e. Viking Corporation.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

F. Adjustable Drop Nipples:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. CECA, LLC.
   b. Corcoran Piping System Co.
   c. Merit Manufacturing; a division of Anvil International, Inc.
5. Size: Same as connected piping.
7. Inlet and Outlet: Threaded.
G. Flexible, Sprinkler Hose Fittings:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   
   a. **Fivalco Inc.**
   
   b. **FlexHead Industries, Inc.**
   
   c. **Gateway Tubing, Inc.**

3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
5. Size: Same as connected piping, for sprinkler.

2.09 SPRINKLERS

A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. **AFAC Inc.**
2. **Globe Fire Sprinkler Corporation.**
3. **Reliable Automatic Sprinkler Co., Inc.**
4. **Tyco Fire & Building Products LP.**
5. **Venus Fire Protection Ltd.**
6. **Vicoustic Company.**
7. **Viking Corporation.**

B. General Requirements:

4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. Residential Applications: UL 1626.
3. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

E. Special Coatings:

1. Wax.
2. Lead.
3. Corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.

   2. Standard: UL 199.
   3. Type: Wire cage with fastening device for attaching to sprinkler.

2.010 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.

2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
5. Size: 10-inch diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
8. Outlet: NPS 1 drain connection.

C. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ADT Security Services, Inc.
   b. McDonnell & Miller; ITT Industries.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
   e. Viking Corporation.
f. Watts Industries (Canada) Inc.

4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
7. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.

3. Type: Electrically supervised.
5. Design: Signals that controlled valve is in other than fully open position.

E. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.

2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.011 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
4. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
D. Pressure Gage Range: 0 to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.01 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.02 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 15 Section "Domestic Water Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.03 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.
I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

N. Drain dry-pipe sprinkler piping.

O. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices or air compressors.

P. Install sleeves for piping penetrations of walls, ceilings, and floors.

Q. Install sleeve seals for piping penetrations of concrete walls and slabs.

R. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.04 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.05 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
   a. Install air compressor and compressed-air supply piping.

3.06 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.07 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.08 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals.
3.09 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.010 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.011 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Dry-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

D. Dry-pipe sprinkler system, NPS 2-1/2 to NPS 6, shall be one of the following:

1. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3.012 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Dry concealed sprinklers.
3. Wall Mounting: Dry sidewall sprinklers.
4. Spaces Subject to Freezing: Dry pendent sprinklers or Dry sidewall sprinklers.
5. Special Applications: Extended-coverage and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211316
SECTION 22 0000
PLUMBING GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 PLUMBING REQUIREMENTS

A. These plumbing requirements are supplemental to the General Requirements of these Specifications. The plumbing sections shall apply to phases of the work specified, shown on the Drawings, or required to provide for the complete installation of plumbing systems for this project.

B. The work shall include all items, articles, materials, operations and methods listed, mentioned, or scheduled in these specifications and the accompanying drawings. All material, equipment, and labor shall be furnished together with all incidental items required by good practice to provide the complete systems described.

C. Examine and refer to all Architectural, Civil, Structural, Electrical, Utility, Landscape and Mechanical drawings and specifications for construction conditions which may affect the mechanical work. Inspect the building site and existing facilities for verification of present conditions. Make proper provisions for these conditions in performance of the work and cost thereof.

D. See general requirements for listed Alternate Bids. Note alternates listed and include any changes in work and price required to meet the requirements of the respective alternate.

1.02 CODES AND STANDARDS

A. Work shall meet the requirements of the plans and specifications and shall not be less than the minimum requirements of applicable sections of the latest Codes and Standards of the following Organizations:

1. American Gas Association (AGA)
2. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
3. American Society of Mechanical Engineers (ASME)
4. American Water Works Association (AWWA)
5. National Electrical Code (NEC)
6. National Electrical Manufacturers Association (NEMA)
7. National Fire Protection Association (NFPA)
8. Uniform Plumbing Code (UPC)
9. Occupational Safety & Health Act (OSHA)
10. Plastic Pipe Institute (PPI)
11. International Mechanical Code (IMC)
14. Requirements of the Serving Utility Company
15. Local and State Codes and Ordinances
1.03 FEES AND PERMITS

A. The Plumbing Contractor shall pay all fees and arrange for all permits required for work done under his contract and under his supervision by subcontract.

B. All usage contracts between the Owner and the serving utilities company, such as membership and usage charges or fees, etc., for the purpose of obtaining the services for the utility company shall be applied for and paid for by the Owner.

1.04 MATERIALS AND EQUIPMENT

A. Manufacturer’s trade names and catalog numbers listed are intended to indicate the quality of equipment or materials desired. Manufacturers not listed in the specification will be considered substitutions and must have prior approval.

B. Written prior approval for substitutions must be submitted to and received by the Architect/Engineer ten (10) days prior to bid opening. Requests for substitution are to be submitted sufficiently ahead of the deadline to give ample time for examination. Prior approval request for substitution must indicate the specific item or items to be furnished in lieu of those scheduled, together with complete technical and comparative data on scheduled items and items proposed for substitution.

C. If the engineer approves any proposed substitution, the approved product will be listed in an addendum. Bidders shall not rely on approval made in any other manner.

D. Plumbing equipment may be installed with manufacturer’s standard finish and color except where specific color, finish or choice is indicated. If the manufacturer has no standard finish, equipment shall have a prime coat and two finish coats of gray enamel, fixtures shall be white and faucets & trim shall be chrome.

E. High altitude operation: Capacity of all equipment is to be sized and manufactured to perform at the elevation of the project site. If not specifically indicated in the equipment schedule or in the specifications provide all required accessories and equipment for proper operation at elevation of the project site.

F. This Contractor shall be responsible for materials and equipment installed under this contract. Contractor shall also be responsible for the protection of materials and equipment of others from damage as a result of his work.

G. Manufactured material and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by manufacturer unless herein specified to the contrary.

H. This Contractor shall make the required arrangement with General Contractor or Construction Manager for the introduction into the building of equipment too large to pass through finished openings.

I. Store materials and equipment indoors at the job site or, if this is not possible, store on raised platforms and protect from the weather by means of waterproof covers. Coverings shall permit circulation of air around the materials to prevent condensation of moisture. Screen or cap openings in equipment to prevent the entry of vermin.
1.05 INTENT OF DRAWINGS

A. The drawings are partly diagrammatic and do not necessarily show exact location of piping and equipment unless specifically dimensioned. Riser and other diagrams are schematic and do not necessarily show the physical arrangement of the equipment. They shall not be used for obtaining lineal runs of piping or ductwork, nor shall they be used for shop drawings for piping fabrication or ordering. Discrepancies shown on different plans, or between plans and actual field conditions shall be brought to the attention of the Architect/Engineer for resolution.

1.06 RESPONSIBILITY

A. The Plumbing Contractor shall be responsible for the installation of a satisfactory and complete system in accordance with the intent of the drawing and specifications. Provide, at no extra cost, all incidental items, materials, accessories and labor required for completion of the work even though they are not specifically mentioned or indicated on the drawings or in the specifications.

B. The drawings do not attempt to show complete details of the building construction which affect the mechanical installation; and reference is therefore required to the Architectural, Civil, Structural, Landscape and Electrical drawings and specifications and to shop drawings of all trades for additional details which affect the installation of the work covered under this Division of the Contract.

C. Location of plumbing system components shall be checked for conflicts with openings, structural members and components of other systems having fixed locations. In the event of any conflicts, the Architect/Engineer shall be consulted and his decision shall govern. Necessary changes shall be made at the Contractor’s expense.

D. Determine, and be responsible for, the proper location and character of inserts for hangers, chases, sleeves, and other openings in the construction required for the work, and obtain this information well in advance of the construction progress so work will not be delayed.

E. Final location of inserts, hangers, etc., required for each installation, must be coordinated with facilities required for other installations to prevent interference.

F. Take extreme caution not to install work that connects to equipment until such time as complete submittal of such equipment has been reviewed by the Architect/Engineer. Any work installed by the Contractor, prior to approval of the submittal, will be at the Contractor’s risk.

G. All modifications and changes required due to installation of substituted equipment shall be made at the contractor’s expense.

H. It shall be the responsibility of the installing contractor to coordinate changes to work by other trades that result from the installation of equipment other than the scheduled equipment.

I. If the provided equipment is heavier or larger than the scheduled or specified equipment, it shall be the responsibility of the installing contractor to coordinate the required structural changes and pay for any and all associated cost.

J. If the provided equipment has different motor characteristics or electrical requirements than the scheduled or specified equipment, it shall be the responsibility of the installing contractor to coordinate the required changes and pay for any and all associated cost.
K. If larger or additional electrical conduits are required due to the installation of equipment other than the scheduled or specified equipment it shall be the responsibility of the installing contractor to coordinate the required changes and pay for any and all associated cost.

L. If the provided equipment requires different fluid flow rates than the scheduled or specified equipment, it shall be the responsibility of the installing contractor to coordinate all required changes including but not limited to pumps, piping, valves, etc and pay for any and all associated cost.

M. At all times during the performance of this Contract, properly protect work from damage and protect the Owner's property from injury of loss. Make good any damage, injury or loss, except such as may be directly due to errors in the Bidding Documents or caused by Agents or Employees of the Owner. Adequately protect adjacent property as provided by law and the Bidding Documents. Provide and maintain passageways, guard fences, lights and other facilities for protection required by Public Authority or Local conditions.

N. The Plumbing Contractor shall be responsible for damages due to the work of their contractors, to the building or its contents, people, etc.

1.07 REVIEW

A. All work and material is subject to review at any time by the Architect/Engineer or his representative. If the Architect/Engineer or his representative finds material that does not conform to these specifications or that is not properly installed or finished, correct the deficiencies in a manner satisfactory to the Architect/Engineer at the Contractor's expense.

1.08 WORKMANSHIP

A. GENERAL

1. Work under this contract shall be performed by workmen skilled in the particular trade, including work necessary to properly complete the installation in a workmanlike manner to present a neat and finished appearance.

B. CUTTING, PATCHING, AND FRAMING

1. Obtain Architect's/Engineer's approval before performing any cutting on structural members or patching of building surfaces. Any damage to the building or equipment by this Contractor shall be the responsibility of this Contractor and shall be repaired by skilled craftsmen of the trades involved at the Contractor’s expense.

2. Chases, openings, sleeves, hangers, anchors, recesses, equipment pads, framing for equipment, provided by others only if so noted on the drawings. Otherwise, they will be provided by this Contractor for his work. Whether chases, etc., are provided by this Contractor or others, this Contractor is responsible for correct size and locations.

1.09 COORDINATION

A. The Plumbing Contractor shall plan his work to proceed with a minimum interference with other trades and it shall be his responsibility to inform the General Contractor of all openings required in the building structure for installation of work, and to provide sleeves as required. Dimensions of equipment installed and/or provided by others shall be checked in order that correct clearances and connections may be made.
B. In general, pipelines requiring gravity drainage shall be installed first, followed by large piping mains, ductwork and electrical conduit. The location fire protection piping and heads shall be coordinated with other trades to ensure that installations by other trades do not block heads.

C. Leave sufficient space for the installation of insulation on piping and ductwork as specified. It is not acceptable to compress pipe or duct insulation for any reason.

1.10 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish caused by his work or employees.

B. Upon completion of work, remove materials, scraps and debris relative to his work and leave the premises, including tunnels, crawl spaces, and pipe chases in clean and orderly condition. Remove all dirt and debris from the interior and exterior of all devices and equipment. After construction is completed, wash all mechanical equipment.

1.11 DUST PROTECTION

A. The Plumbing Contractor will provide suitable dust protection for all existing areas prior to beginning of cutting or demolition. Contractor will obtain approval of partition from Owner before proceeding with work involved in these rooms.

1.12 TEMPORARY FACILITIES

A. OFFICES

1. The Plumbing Contractor may provide a temporary office for himself and for the periodic use by the Architect/Engineer. Coordinate the location or temporary offices with the General Contractor/Construction Manager and owner.

B. REMOVAL

1. The Plumbing Contractor shall completely remove his temporary installations when no longer needed and the premises shall be completely clean, disinfected, patched, and refinished to match adjacent areas.

C. LADDERS AND SCAFFOLDS

1. The Plumbing Contractor shall provide their own ladders, scaffolds, etc. of substantial construction for access to their work in various portions of the building as may be required. When no longer needed, they shall be removed by the Plumbing Contractor.

D. PROTECTION DEVICES

1. The Plumbing Contractor shall provide and maintain his own necessary barricades, fences, signal lights, etc., required by all governing authorities or shown on the drawings. When no longer needed, they shall be removed by the Plumbing Contractor. The Plumbing Contractor shall assume all responsibility for which the Owner may be held responsible because of lack of above items.

E. TEMPORARY FIRE PROTECTION
1. The Plumbing Contractor shall provide all necessary first aid hand fire extinguishers for Class A, B, C and special hazards as may exist in his own work area only in accordance with good and safe practice and as required by jurisdictional safety authority. The General Contractor or Constriction Manager shall provide general area fire extinguishers only.

1.13 SHOP DRAWINGS

A. Submittal Schedule:

1. Prior to submitting any submittals, the plumbing contractor shall provide a schedule of all submittals. The schedule shall indicate the following:

   a. Specification Section
   b. Equipment/Material Name or Mark
   c. Submittals Type Required: Product Data, Shop Drawing, Delegated Design, O&M Data

B. Submittals will be required for each item of material and equipment furnished as noted in specifications.

C. All submittals shall be electronic and submitted in PDF format. If multiple specifications, products or materials are included in a submittal, combine all information including transmittal information into one file.

D. Shop drawings and literature shall be complete clearly show item used, size, dimensions, capacity, rough in, etc., as required for complete check and installation. Manufacturer’s literature showing more than one item shall be clearly marked as to which item is being furnished or it will be rejected and returned without review.

E. Each copy of each item submitted must be clearly marked as follows for purposes of identification and record. Submittals not marked (typewritten only) as described below will be rejected and returned without review.

F. Date:

G. Name of Project:

H. Branch of Work:

I. Submitted by:

J. Specification or Plan Reference:

K. Prior to their submission, each submittal shall be thoroughly checked by the Plumbing Contractor for compliance with the Contract Document requirements, accuracy of dimensions, relationship to the work of other trades, and conformance with sound, safe practices as to erection and installation. Each submittal shall then bear a stamp evidencing such checking and shall show corrections made, if any. Submittals requiring extensive corrections shall be revised before submission. Each submittal not stamped and signed by the Plumbing Contractor evidencing such checking will be rejected and returned without review.
L. All submittals will be examined when submitted in proper form for compliance. Such review shall not relieve the Plumbing Contractor of responsibility for errors, for deviation from the contract Documents, nor for violation of sound safety practices.

M. The Plumbing Contractor shall keep in the field office one print of each submittal which has been reviewed and stamped by the Architect or Engineer.

N. Submittals which are incomplete relative to quality requirements, capacity, engineering data, dimensional data or detailed list of specialty or control equipment will be rejected. Lists shall include descriptive coding as specified or shown on drawings.

O. Review of the shop drawings and literature by the engineer shall not relieve the contractor for responsibility for deviations for the drawings or specifications, nor shall it relieve the contractor from responsibility for errors in the shop drawings or literature. It is the responsibility of the contractor to provide materials and equipment which meet the specifications and job requirements.

1.14 OPERATION AND MAINTENANCE MANUALS

A. At the time orders are placed for any item of equipment requiring service or operating maintenance, the Contractor shall request the manufacturer furnish three (3) copies of OPERATION AND MAINTENANCE INSTRUCTIONS for each piece of equipment. These shall be included in the brochure of equipment.

1.15 BROCHURE OF EQUIPMENT

A. Upon completion of work, prepare "Brochure of Equipment" containing data pertinent to equipment and systems on job. Binders containing materials shall be one or more three ring binders of sufficient number to hold all literature. Contained in binders shall be: Installation, maintenance, and operating instructions for each piece of equipment; parts lists; wiring diagrams; one copy of each shop drawing and literature submittal; record drawings, etc.

B. All literature shall be clean, unused and filed under divider headings corresponding to the specifications.

C. These brochures shall be submitted to the Architect/Engineer and owner for review and approved. Final hard and electronic (PDF) copies shall be provided to the owner before authorization of final payment.

1.16 AS BUILT DRAWINGS

A. The Plumbing Contractor shall furnish to the Owner and Architect/Engineer a marked print showing the location of all concealed or underground pipe or conduit runs and other equipment installed other than as shown on the drawings. Dimension underground lines from established building lines. Indicate all installed pull boxes in conduit runs.

B. The Plumbing Contractor shall furnish to the Architect/Engineer a marked print showing the location of all mechanical equipment, plumbing fixtures, piping, ductwork, diffusers, grilles, etc. The location of any item which deviates from the bid documents shall be accurately drawn and dimensioned.
1.17 PLACING SYSTEMS IN OPERATION

A. Start-up of all plumbing equipment shall be completed by factory trained representatives. At the completion of start-up, the factory representative shall submit to the architect and engineer, a start-up report that indicates any problems encountered, potential problems including installation issues, adjustments made or required to be made to ensure proper operation.

B. At the completion of the work and at such time as the Owner shall direct, prior to final acceptance, the Contractor performing this work shall put into satisfactory operation the various systems installed under the specifications. At no additional cost to the Owner, furnish the services of a person completely familiar with the installations performed under this specification, to instruct the Owner’s operating personnel in the proper operation and servicing of the equipment and systems. These services shall be available for a period of no less than one (2) days.

1.18 WARRANTY

A. The Contractor shall guarantee that all materials and labor installed are new and of first quality and that any material or labor found defective shall be replaced without cost to the Owner within one (1) year after substantial completion of the Contract or one (1) full season of heating and cooling operation, whichever is the greater. The guarantee shall list the date of the beginning of the one (1) year period, which shall be the date that the Substantial Completion Certificate is issued.

B. Any damage to the building, caused by defective work or material of the Contractor within the above-mentioned period, shall be satisfactorily repaired without cost to the Owner.

C. The guarantee does not include maintenance of equipment. The Owner shall accept full responsibility for proper operation and maintenance of equipment immediately upon substantial completion and occupancy of the building.

D. Final acceptance by the Owner will not occur until all operating instructions are mounted in Equipment Rooms and Operating Personnel thoroughly indoctrinated in the operation of all mechanical equipment by the Contractor.

E. No equipment installed as part of this project shall be used for temporary heat during construction.

END OF SECTION
SECTION 22 0517

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Sleeve-seal systems.

1.2 ACTION SUBMITTALS

A. Product Data: None Required

PART 2 - PRODUCTS

2.1 SLEEVES

A. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Advance Products & Systems, Inc
   2. CALPICO, Inc
   3. Metraflex Company (The)
   4. Pipeline Seal and Insulator, Inc
   5. Proco Products, Inc

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

   1. Sealing Elements: EPDM-rubber or NBR 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.
   3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT


B. Characteristics: Nonshrink; recommended for interior and exterior applications.
C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

**PART 3 - EXECUTION**

**3.1 SLEEVE INSTALLATION**

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   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 (50 mm) above finished floor level.
   2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

**3.2 SLEEVE-SEAL-SYSTEM INSTALLATION**

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

**3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE**

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls above Grade:
      a. Galvanized-steel wall sleeves.
2. Exterior Concrete Walls below Grade:
   a. Galvanized-steel wall sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:
   a. Galvanized-steel-pipe sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:
   a. Galvanized-steel-pipe sleeves.

5. Interior Partitions:
   a. Galvanized-steel-pipe sleeves.

END OF SECTION 22 0517
SECTION 22 0518
ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Escutcheons.
   2. Floor plates.

1.2 ACTION SUBMITTALS
A. Product Data: None Required

PART 2 - PRODUCTS

2.1 ESCUTCHEONS
A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES
A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
      f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
      g. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 22 0518
SECTION 22 0523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Bronze ball valves.
   2. Iron, single-flange butterfly valves.

1.2 SUBMITTALS

A. Product Data:
   1. Ball valves
   2. Butterfly valves
   3. Check valves

1.3 QUALITY ASSURANCE

A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

B. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set angle, gate, and globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Set butterfly valves closed or slightly open.
   6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.
B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:
   1. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller.

E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
   1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Solder Joint: With sockets according to ASME B16.18.
   3. Threaded: With threads according to ASME B1.20.1.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Valve, Inc.
      b. Conbraco Industries, Inc.; Apollo Valves.
      c. Milwaukee Valve Company.
      d. NIBCO INC.
      e. Red-White Valve Corporation.
      f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

   2. Description:
      b. SWP Rating: 150 psig (1035 kPa).
      c. CWP Rating: 600 psig (4140 kPa).
      d. Body Design: Two piece.
      e. Body Material: Bronze.
      f. Ends: Threaded.
      g. Seats: PTFE or TFE.
      h. Stem: Bronze.
      i. Ball: Chrome-plated brass.
      j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. **DeZurik Water Controls.**
b. **Milwaukee Valve Company.**
c. **NIBCO INC.**
d. **Red-White Valve Corporation.**
e. **Watts Regulator Co.; a division of Watts Water Technologies, Inc.**

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: **150 psig (1035 kPa).**
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.

### 2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

   a. **American Valve, Inc.**
   b. **Milwaukee Valve Company.**
   c. **NIBCO INC.**
   d. **Red-White Valve Corporation.**
   e. **Watts Regulator Co.; a division of Watts Water Technologies, Inc.**

2. Description:

   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: **200 psig (1380 kPa).**
   c. Body Design: Horizontal flow.
   e. Ends: Threaded.
   f. Disc: Bronze.

### PART 3 - EXECUTION

#### 3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.
3.2 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly valves.
2. Throttling Service: ball, or butterfly valves.
3. Pump-Discharge Check Valves:
   a. Bronze swing check valves with bronze disc.

B. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125, bronze disc.
3. Ball Valves: Two piece, full port, bronze with bronze trim.
4. Bronze Swing Check Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to NPS 100): May be provided with threaded ends instead of flanged ends.
3. Iron Swing Check Valves: Class 125, metal seats.

END OF SECTION 22 0523
SECTION 22 0529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Thermal-hanger shield inserts.
   4. Fastener systems.
   5. Pipe positioning systems.
   6. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
   1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. None Required

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Pregalvanized or hot dipped is required in corrosive environments and where piping is in direct contact with the hanger. Plane carbon steel is acceptable in non-corrosive environments and where insulation or insulation inserts are installed between the piping and the hanger.
B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:
1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
   b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
   c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
   d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.
3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 2-1/2 to NPS 30 (DN 15 to DN 750).
   2. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 2 (DN 15 to DN 200).
   3. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
   4. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
   5. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
   6. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
   7. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
   2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
   3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. **Welded Beam Attachments (MSS Type 22):** For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. **C-Clamps (MSS Type 23):** For structural shapes.

7. **Welded-Steel Brackets:** For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   
   a. **Light (MSS Type 31):** 750 lb (340 kg).
   b. **Medium (MSS Type 32):** 1500 lb (680 kg).
   c. **Heavy (MSS Type 33):** 3000 lb (1360 kg).

8. **Side-Beam Brackets (MSS Type 34):** For sides of steel or wooden beams.

9. **Plate Lugs (MSS Type 57):** For attaching to steel beams if flexibility at beam is required.

M. **Saddles and Shields:** Unless otherwise indicated and except as specified in piping system Sections, install the following types:

   1. **Steel-Pipe-Covering Protection Saddles (MSS Type 39):** To fill interior voids with insulation that matches adjoining insulation.
   2. **Protection Shields (MSS Type 40):** Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. **Thermal-Hanger Shield Inserts:** For supporting insulated pipe.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

P. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

**END OF SECTION 22 0529**
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. 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. Restraining braces and cables.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.
   a. Component Importance Factor:
      1) Plumbing Piping & Plumbing Equipment: 1.0
      2) Fuel Gas Piping: 1.5
   b. Component Response Modification Factor: Per ASCE 7-10
   c. Component Amplification Factor: Per ASCE 7-10

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.722g
4. Design Spectral Response Acceleration at 1-Second Period: 0.212g

1.3 ACTION SUBMITTALS

A. Product Data:

1. Vibration Isolators
2. Seismic-Restraint Devices

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.
B. Welding certificates.
C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved 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.

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. Mason Industries
3. VibroAcoustics

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.

1. Resilient Material: Oil- and water-resistant neoprene.

C. 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.

D. 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.

E. Pipe Riser Resilient Support <Insert drawing designation>: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- (13-mm-) 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 (3.45 MPa) and for equal resistance in all directions.

2.2 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. Cooper B-Line, Inc.; a division of Cooper Industries.
3. Hilti, Inc.
5. VibroAcoustics

B. 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.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

H. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
PART 3 - EXECUTION

3.1 APPLICATIONS

A. For Seismic Design Category A or B (regardless of importance factor), no seismic requirements exist for non-structural systems on this project.

B. For Seismic Design Category C with an importance factor Ip = 1.0, no seismic requirements exist for non-structural systems on this project. However, systems, equipment, or piping may still have an Ip = 1.5.

C. For Seismic Design Category C with an importance factor Ip = 1.5:
   1. In accordance with the International Building Code and ASCE 7, the following piping, ductwork, or equipment is exempt from seismic controls:
      a. Black iron pipe with threaded joints – NOT exempt per code.
      b. PVC/CPVC pipe – NOT exempt per code.
      c. Highly-deformable piping (copper, black iron w/ welded joints or victaulic joints, PEX, cast iron no-hub): piping 2” and smaller is exempt if hung on individual clevis hangers where provisions are made to protect the piping from impact or to avoid the impact of larger piping or other mechanical equipment.
      d. Hanging, wall mounted, and flexibly supported mechanical and plumbing components that weigh 20 pounds or less, and flexible connections are provided between the components and associated ductwork or piping, are exempt.
      e. Piping supported by individual clevis hangers where the distance, as measured from the top of pipe to the supporting structure, is less than 12 inches for the entire pipe run and the pipe can accommodate the expected deflections, are exempt. Trapeze hung piping is exempt where the distance from the top of the trapeze or support to the structure is less than 12 inches for the entire run. Hanger rods shall not be constructed in a manner that would subject the rod to bending moments (swivel, eye bolt, or vibration isolated hanger connections to structure).
      f. HVAC ducts suspended from hangers that are 12 inches or less in length from the top of the duct to the supporting structure are exempt where the hangers are detailed to avoid significant bending of the hangers and their connections.
      g. HVAC ducts that have a cross-sectional area of less than 6 square feet are exempt.
      h. Equipment installed in-line with the duct system (e.g. fans, heat exchangers, humidifiers, terminal boxes) with an operating weight less than 76 pounds are exempt.

D. For Seismic Design Category D with an importance factor Ip = 1.0:
   1. In accordance with the International Building Code and ASCE 7, the following piping, ductwork, or equipment is exempt from seismic controls:
      a. Black iron pipe with threaded joints – NOT exempt per code. Refer to exemption below for distribution systems less than 10 lbs/ft.
      b. PVC/CPVC pipe – NOT exempt per code. Refer to exemption below for distribution systems less than 10 lbs/ft.
      c. Piping and ductwork distribution systems weighing 10 lbs/ft or less are exempt where flexible connectors are provided between the component and the piping or ductwork.
d. Mechanical components weighing 400 lbs or less and installed at 4 ft above the floor or less are exempt where flexible connectors are provided between the component and the associated piping or ductwork.

e. Highly-deformable piping (copper, black iron w/ welded joints or victaulic joints, PEX, cast iron no-hub): piping 3" and smaller is exempt if hung on individual clevis hangers where provisions are made to protect the piping from impact or to avoid the impact of larger piping or other mechanical equipment.

f. Hanging, wall mounted, and flexibly supported mechanical and plumbing components that weigh 20 pounds or less, and flexible connections are provided between the components and associated ductwork or piping, are exempt.

g. Piping supported by individual clevis hangers where the distance, as measured from the top of pipe to the supporting structure, is less than 12 inches for the entire pipe run and the pipe can accommodate the expected deflections, are exempt. Trapeze hung piping is exempt where the distance from the top of the trapeze or support to the structure is less than 12 inches for the entire run. Hanger rods shall not be constructed in a manner that would subject the rod to bending moments (swivel, eye bolt, or vibration isolated hanger connections to structure).

h. HVAC ducts suspended from hangers that are 12 inches or less in length from the top of the duct to the supporting structure are exempt where the hangers are detailed to avoid significant bending of the hangers and their connections.

i. HVAC ducts that have a cross-sectional area of less than 6 square feet are exempt.

j. Equipment installed in-line with the duct system (e.g. fans, heat exchangers, humidifiers, terminal boxes) with an operating weight less than 76 pounds are exempt.

E. For Seismic Design Category D with an importance factor Ip = 1.5:

1. In accordance with the International Building Code and ASCE 7, the following piping, ductwork, or equipment is exempt from seismic controls.

   a. Black iron pipe with threaded joints – NOT exempt per code.
   b. PVC/CPVC pipe – NOT exempt per code.
   c. Highly-deformable piping (copper, black iron w/ welded joints or Victaulic joints, PEX, cast iron no-hub): piping 1" and smaller is exempt if hung on individual clevis hangers where provisions are made to protect the piping from impact or to avoid the impact of larger piping or other mechanical equipment.
   d. Hanging, wall mounted, and flexibly supported mechanical and plumbing components that weigh 20 pounds or less, and flexible connections are provided between the components and associated ductwork or piping, are exempt.
   e. Piping supported by individual clevis hangers where the distance, as measured from the top of pipe to the supporting structure, is less than 12 inches for the entire pipe run and the pipe can accommodate the expected deflections, are exempt. Trapeze hung piping is exempt where the distance from the top of the trapeze or support to the structure is less than 12 inches for the entire run. Hanger rods shall not be constructed in a manner that would subject the rod to bending moments (swivel, eye bolt, or vibration isolated hanger connections to structure).
   f. HVAC ducts suspended from hangers that are 12 inches or less in length from the top of the duct to the supporting structure are exempt where the hangers are detailed to avoid significant bending of the hangers and their connections.
   g. HVAC ducts that have a cross-sectional area of less than 6 square feet are exempt.
   h. Equipment installed in-line with the duct system (e.g. fans, heat exchangers, humidifiers, terminal boxes) with an operating weight less than 76 pounds are exempt.
3.2 The seismic restraint manufacturer shall:

A. Determine seismic restraint layout and sizing per IBC.
B. Provide vibration isolation materials where scheduled later in this specification.
C. Provide pipe flexible connectors where scheduled later in this specification.
D. Provide installation instructions and shop drawings for all materials supplied under this specification.
E. Provide a submittal package including calculations to determine seismic restraint loads resulting from seismic forces per IBC. Calculations shall be certified by licensed engineer in the employ of the seismic equipment manufacturer with a minimum 5 years experience. Calculations and restraint device submittal drawings shall specify anchor bolt type, embedment, concrete compressive strength, minimum spacing between anchors, and minimum distances of anchors to concrete edges.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:
   1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
   2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:
   1. Comply with requirements in MSS SP-127.
   2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
   3. Brace a change of direction longer than 12 feet.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. 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.

G. 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. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

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 Division 15 Section "Hydronic Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Engineer, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days’ advance notice.
4. Test at least four of each type and size of installed anchors and fasteners selected by Engineer.
5. Test to 90 percent of rated proof load of device.
7. Measure isolator deflection.
8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.6 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.

3.7 PLUMBING VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. Piping:
1. All piping as required in the Design Category and Importance factor listed above.
2. All piping within 20 feet of a pump.

END OF SECTION 22 0548
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Pipe labels.
   3. Valve Tags
   4. Valve Schedule

1.2 ACTION SUBMITTAL

A. Product Data:
   1. None Required

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 
      1/8 inch thick, and having predrilled holes for attachment hardware.
   2. Letter Color: Black.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 
      2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 
      inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering 
      for greater viewing distances. Include secondary lettering two-thirds to three-fourths the 
      size of principal lettering.
   7. Fasteners: Stainless-steel rivets or self-tapping screws.
   8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content:
   1. Zone Level Equipment (VAV boxes, Cabinet Heaters, Fin tube heaters, etc): Include 
      equipment’s Drawing designation or unique equipment number.
   2. Plant Level Equipment (Boilers, Chillers, Fluid Coolers, Circulating Pumps, Expansion 
      Tanks, etc): Include equipment’s Drawing designation or unique equipment number, and 
      primary performance data (Heating and/or Cooling Capacity, Flow Rates, Working Fluid, 
      Refrigerant type, Electrical Data (Voltage, Phase, Load).

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch 
   bond paper. Tabulate equipment identification number and identify Drawing numbers where 
   equipment is indicated (plans, details, and schedules), plus the Specification Section number 
   and title where equipment is specified. Equipment schedule shall be included in operation and 
   maintenance data.
2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pipe Labels: Self-adhesive type. Provide Seton “Xtreme-code” or equal.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.3 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4 mm) letters for piping system abbreviation and 1/2-inch (13 mm) numbers, with numbering scheme approved by Engineer. Provide 5/32-inch (4 mm) hole for fastener.
   1. Material: 0.032-inch (0.8-mm) thick brass or aluminum.
   2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

2.4 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-Schedule Frames: Glazed display frame for removable mounting on walls for each page of valve schedule. Include mounting screws.
   2. Frame: Extruded aluminum.
   3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5 mm, single-thickness glass.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

B. Pipe Label Color Schedule:

1. Domestic Hot Water Piping:
   a. Background Color: Green.
   b. Letter Color: Red.
2. Domestic Cold Water Piping:
   a. Background Color: Green.
3. Sanitary Waste and Vent Piping:
   a. Background Color: Blue.
   b. Letter Color: Black.
4. Rainwater (Storm) Drain:
   a. Background Color: Blue.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

1. Valve-Tag Size and Shape: (38 mm).
2. Valve-Tag Color: Natural Brass or Aluminum.

3.5 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location in each major equipment room.

3.6 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 22 0553
PART 1 - GENERAL

1.01 SUMMARY

A. Section includes insulating the following plumbing piping services:
   1. Domestic hot-water piping.
   2. Domestic recirculating hot-water piping.
   3. Roof drains and rainwater leaders.
   4. Under sink & lavatory piping covers.

1.02 ACTION SUBMITTALS

A. Product Data:
   1. Insulation Materials
   2. Adhesives
   3. Mastics
   4. Sealants
   5. Factory Applied Jackets
   6. Field Applied Jackets
   7. Tapes

1.03 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements shown on the drawings and included in the Piping Insulation Schedule in Part 3 of this specification.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Under Sink & Lavatory Piping Covers:

1. Products: provide one of the following:
   a. Plumberex Pro-Extreme
   b. Truebro Lav Guard 2
   c. Prior Approved Equal

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Fibrex Insulations Inc.; Coreplus 1200
   b. Johns Manville; Micro-Lok
   c. Knauf Insulation; 1000-Degree Pipe Insulation
   d. Manson Insulation Inc.; Alley-K
   e. Owens Corning; Fiberglas Pipe Insulation

H. Thermal Insulating Wool:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Owens Corning Fiberglas TIW Type I
   b. Thermafiber Safing
   c. Prior Approved Equal

2. Type I, 1000 deg F Materials: Mineral or glass fibers bonded with thermosetting resin. Comply with ASTM C 533, Type I and ASTM C 795.
3. Thermal Conductivity: 0.27 btu-in/hr-ft²-F
4. Thickness: Match thickness of adjacent pipe insulation.

2.02 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:
   b. Eagle Bridges - Marathon Industries; 225
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70
   d. Mon-Eco Industries, Inc.; 22-25
2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:
   b. Eagle Bridges - Marathon Industries; 225.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Corning Corporation; 739, Dow Silicone.
   d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.03 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
   b. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

2.04 SEALANTS

A. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. **Products:** Subject to compliance with requirements, provide the following:

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.05 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.06 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. **Products:** Subject to compliance with requirements, provide one of the following:
   a. Johns Manville; Zeston.
   c. Proto Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.07 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.08 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy, or 0.062-inch soft-annealed, stainless steel, or 0.062-inch soft-annealed, galvanized steel.
PART 3 - EXECUTION

3.01 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation and all exposed ends with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
K. Apply adhesives, mastics, and sealants at manufacturer’s recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe.
   a. For below-ambient services, apply vapor-barrier mastic over all joints and seams.
4. Cover joints and seams with tape, according to insulation material manufacturer’s written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
5. Handholes.
6. Cleanouts.

3.03 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.
B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 07 8413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 8413 "Penetration Firestopping."

3.04 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. All piping fittings shall be insulated by filling the total void over all fittings between straight runs of pipe insulation with thermal insulating wool, forming a uniform insulation thickness equal to, or exceeding, the adjacent pipe insulation. Finish all insulated pipe fittings by applying PVC fitting covers overlapping the adjacent pipe insulation outer covering. For hot service piping, secure the PVC fitting covers stainless steel tack fasteners. For cold service piping, seal the ends of the adjacent pipe insulation with vapor barrier mastic, ensure that the PVC fitting cover overlaps the adjacent pipe insulation jacket by 2” minimum and secure PVC fitting covers to adjacent pipe insulation with 2” wide PVC Tape.
   2. Insulate valves with removable insulation jackets. For valves 2” and smaller use “No Sweat” re-usable valve covers or approved equal product. For valves 2-1/2” and larger use removable insulation jackets from Thermaxx or prior approved manufacturer.
   3. Insulate strainers with removable insulation jackets. For strainers 2” and smaller use “No Sweat” re-usable valve covers or approved equal product. For strainers 2-1/2” and larger use removable insulation jackets from Thermaxx or prior approved manufacturer.
4. Insulate flanges and unions with removable insulation jackets. For flanges and unions 2” and smaller use “No Sweat” re-usable valve covers or approved equal product. For flanges and unions 2-1/2” and larger use removable insulation jackets from Thermaxx or prior approved manufacturer.

5. PVC fitting covers for grooved piping systems shall be the type designed for use with grooved fittings and couplings to allow sufficient space for the required thickness of insulation.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.05 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   
   1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.06 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.07 INDOOR PIPING INSULATION SCHEDULE

A. See Drawings.

3.08 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Exposed Piping:
1. PVC

C. Concealed Piping
   1. ASJ

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aboveground domestic water pipes, tubes, and fittings inside buildings.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Water Meters

1.3 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in “Piping Schedule” Article and the schedule on the drawings for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.


E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:
   1. MSS SP-123.
   4. Solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
C. Solder Filler Metals: ASTM B 32, lead-free alloys.
D. Flux: ASTM B 813, water flushable.
E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 TRANSITION FITTINGS

A. General Requirements:
1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
1. Dielectric Unions are not allowed.

C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
   b. Central Plastics Company.
   c. Matco-Norca.
   d. Watts; a division of Watts Water Technologies, Inc.
   e. Wilkins; a Zurn company.

3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 175 psig (1200 kPa).
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. **Advance Products & Systems, Inc.**

b. **Calpico, Inc.**

c. **Central Plastics Company.**

d. **Pipeline Seal and Insulator, Inc.**

2. Nonconducting materials for field assembly of companion flanges.


4. Gasket: Neoprene or phenolic.

5. Bolt Sleeves: Phenolic or polyethylene.


**E. Dielectric Nipples:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. **Elster Perfection Corporation.**
   
   b. **Grinnell Mechanical Products; Tyco Fire Products LP.**
   
   c. **Matco-Norca.**
   
   d. **Precision Plumbing Products, Inc.**
   
   e. **Victaulic Company.**


3. Electroplated steel nipple complying with ASTM F 1545.

4. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C).

5. End Connections: Male threaded or grooved.


**F. Water Meters:**

1. Description: Compound type with combined turbine and disk measuring elements.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Neptune
   
   b. Prior approved equal

3. Size: see plans for size

4. No lead construction – ANSI/NSF 61 Certified

5. Maximum operating pressure: 150 psi

6. Maximum operating temperature: 80F

7. Register: Tricon S: direct reading, center sweep, roll-sealed, magnetic drive with low-flow indicator

8. Measuring element: AWWA Class I Turbine & Nutating disc

9. Options:

10. Units of measure: U.S. gallons

11. Register Type: Provide meter with Tricon S Register that transmits pulsed outputs for connection to building utility metering system. The Water meters shall provide a compatible signal to buildings smart metering equipment.

12. Bronze companion flanges

PART 3 - EXECUTION

3.1 EARTHWORK
   A. Comply with requirements in other Sections for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION
   A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

   B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 22 0519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 22 1119 "Domestic Water Piping Specialties."

   C. Install shutoff valve immediately upstream and downstream of each dielectric fitting.

   D. Install water-pressure-reducing valves downstream from shutoff valves.

   E. Install domestic water piping level with 0.25 percent slope downward toward drain or without pitch and plumb.

   F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

   G. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

   H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

   I. 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.

   J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

   K. Install piping to permit valve servicing.

   L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

   M. Install piping free of sags and bends.

   N. Install fittings for changes in direction and branch connections.

   O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
P. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 22.0519 "Meters and Gages for Plumbing Piping."

Q. Install thermostats in hot-water circulation piping.

R. Install thermometers on inlet and outlet piping from each water heater.

S. Install sleeves for piping penetrations of walls, ceilings, and floors.

T. Install sleeve seals for piping penetrations of concrete walls and slabs.

U. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.
3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 to NPS 4: Use dielectric nipples.

C. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
7. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
8. Install supports for vertical copper tubing every 10 feet (3 m).
F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. **NPS 1-1/4 (DN 32) and Smaller**: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.

2. **NPS 1-1/2 (DN 40)**: 108 inches (2700 mm) with 3/8-inch (10-mm) rod.

3. **NPS 2 (DN 50)**: 10 feet (3 m) with 3/8-inch (10-mm) rod.

4. **NPS 2-1/2 (DN 65)**: 11 feet (3.4 m) with 1/2-inch (13-mm) rod.

5. **NPS 3 and NPS 3-1/2 (DN 80 and DN 90)**: 12 feet (3.7 m) with 1/2-inch (13-mm) rod.

6. **NPS 4 and NPS 5 (DN 100 and DN 125)**: 12 feet (3.7 m) with 5/8-inch (16-mm) rod.

7. **NPS 6 (DN 150)**: 12 feet (3.7 m) with 3/4-inch (19-mm) rod.

8. **NPS 8 to NPS 12 (DN 200 to DN 300)**: 12 feet (3.7 m) with 7/8-inch (22-mm) rod.

9. Install supports for vertical steel piping every 15 feet (4.5 m).

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

### 3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.

2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for **NPS 2-1/2 (DN 65)** and larger.

E. Coordinate wiring between the water meter register and the building smart metering equipment with the electrical contractor. Provide all labor and materials required for a complete installation.

### 3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 22 0553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.
3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:
   a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
      2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
   c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
   d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:
   a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
   c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
   f. Prepare reports for tests and for corrective action required.
   g. After press-seal fittings have been installed a "step test" shall be followed. Utilizing air, water, or dry nitrogen, pressurize the system not to exceed 85 psi. Walk the system and check for leaks. If you do not locate any leaks proceed to pressurize the system to the recommended pressures, not to exceed 600 psi. Should you locate a leaking joint that has not been pressed, relieve the pressure from the system, insure the tube is fully inserted into the fitting and proceed to press the fitting. Should you locate a fitting that is leaking that has been previously pressed, you can press the fitting a second time. Resume test procedure, after the necessary repairs have been made.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.
3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
   b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   d. Repeat procedures if biological examination shows contamination.
   e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 WATER METERS

1. Install per manufacturer’s instructions
2. Coordinate connection of meters register to the building metering system with the electrical contractor.
3.13  PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. See drawings for pipe schedule.

END OF SECTION 22 1116
SECTION 22 1316
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Pipe, tube, and fittings.
   2. Specialty pipe fittings.

1.2 PERFORMANCE REQUIREMENTS
A. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.3 ACTION SUBMITTALS
A. Product Data:
   1. None Required

1.4 QUALITY ASSURANCE
A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS
A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS
A. Pipe and Fittings: ASTM A 888 or CISPI 301.
B. CISPI, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ANACO-Husky.
      c. Fernco Inc.
      d. Matco-Norca, Inc.
      e. MIFAB, Inc.
      f. Mission Rubber Company; a division of MCP Industries, Inc.
      g. Stant.
      h. Tyler Pipe.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.5 CLEANOUTS

A. Exterior Surfaced Areas: JR Smith Model # 4223 Cast iron Cleanout with round heavy duty cast iron top, threaded bronze taper plug or prior approved equal.

B. Exterior Unsurfaced Areas: JR Smith Model # 4223 Cast iron Cleanout with round heavy duty cast iron top, threaded bronze taper plug or prior approved equal set in 24"x24" concrete pad set level with adjacent grade.

C. Interior Finished Floor Areas: JR Smith Model # 4140 Cast Iron Cleanout with round secured nickel bronze top with 1/8" tile recess, taper thread bronze plug or prior approved equal.

D. Interior Finished Wall Areas: JR Smith Model # 4470 Cast Iron Cleanout with bronze taper plug, stainless steel round cover or prior approved equal.
PART 3 - ECUTION

3.1 EARTH MOVING
A. Comply with requirements for excavating, trenching, and backfilling specified in other Sections of this Specification.

3.2 PIPING INSTALLATION
A. 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.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed. Install bedding material under piping.

K. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
   1. Building Sanitary Drain: 1/4 inch per foot downward in direction of flow for piping NPS 3 and smaller; 1/8 inch per foot downward in direction of flow for piping NPS 4 and larger.
   2. Vent Piping: 1/8 inch per foot down toward vertical fixture vent or toward vent stack.
L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

M. Install aboveground PVC piping according to ASTM D 2665.

N. Install underground PVC piping according to ASTM D 2321.

O. Plumbing Specialties:
   1. Cleanouts shall be installed at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping.
   2. Cleanouts shall be installed 50ft in horizontal piping and at each chance in direction that exceed 135 degrees.
   3. Cleanouts shall be rated to withstand the maximum static pressure generated in the system.

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors.

R. Install sleeve seals for piping penetrations of concrete walls and slabs.

S. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

C. Plastic, Nonpressure-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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in OD's.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 22.0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22.0529 "Hangers and Supports for Plumbing Piping and Equipment."
1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Install individual, straight, horizontal piping runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
D. Support vertical piping and tubing at base and at each floor.
E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
   5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
   6. Install supports for vertical cast-iron soil piping every 15 feet.
G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
   2. NPS 3: 48 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
   5. Install supports for vertical PVC piping every 48 inches.
H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS
A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. **Plumbing Fixtures:** Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. **Plumbing Fixtures and Equipment:** Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. **Plumbing Specialties:** Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. **Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.**
5. **Equipment:** Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 22 0553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. **Roughing-in Inspection:** Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. **Final Inspection:** Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. **Reinspection:** If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. **Reports:** Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping as follows:

1. **Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.** If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. **Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved.** Expose work that was covered or concealed before it was tested.
3. **Roughing-in Plumbing Test Procedure:** Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. **Finished Plumbing Test Procedure:** After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping.
system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in
trap of water closet to measure this pressure. Air pressure must remain constant without
introducing additional air throughout period of inspection. Inspect plumbing fixture
connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until
satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and
to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-
   based latex paint.

3.10 PIPING SCHEDULE

A. See Drawings for the Piping Schedule.

END OF SECTION 22 1316
SECTION 22 1413
FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pipe, tube, and fittings.
   2. Specialty pipe fittings.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Storm drainage piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.3 ACTION SUBMITTALS

A. Product Data: None Required

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.


PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 ROOF DRAINS

1. See section 224100 for roof drains.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:
   1. **Manufacturers**: Subject to compliance with requirements, provide products by one of the following:
      a. ANACO-Husky.
      c. Fernco Inc.
      d. Matco-Norca, Inc.
      e. MIFAB, Inc.
      f. Mission Rubber Company; a division of MCP Industries, Inc.
      g. Stant.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.

B. Cleanouts:

1. Exterior Surfaced Areas: JR Smith Model # 4223 Cast iron Cleanout with round heavy duty cast iron top, threaded bronze taper plug or prior approved equal.
2. Exterior Unsurfaced Areas: JR Smith Model # 4223 Cast iron Cleanout with round heavy duty cast iron top, threaded bronze taper plug or prior approved equal set in 24"x24" concrete pad set level with adjacent grade.
3. Interior Finished Floor Areas: JR Smith Model # 4140 Cast Iron Cleanout with round secured nickel bronze top with 1/8" tile recess, taper thread bronze plug or prior approved equal.
4. Interior Finished Wall Areas: JR Smith Model # 4470 Cast Iron Cleanout with bronze taper plug, stainless steel round cover or prior approved equal.
PART 3 - EXECUTION

3.1 EARTH MOVING
A. Comply with requirements for excavating, trenching, and backfilling is specified in other Sections of this Specification.

3.2 PIPING INSTALLATION
A. 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 from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

I. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

K. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
   1. Building Storm Drain:  1 / 4 inch per foot downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 / 4 inch per foot downward in direction of flow for piping NPS 4 (DN 100) and larger.
   2. Horizontal Storm-Drainage Piping:  1 / 4 inch per foot downward in direction of flow.

L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
M. Install aboveground PVC piping according to ASTM D 2665.

N. Install underground PVC piping according to ASTM D 2321.

O. Plumbing Specialties:
   1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors.

R. Install sleeve seals for piping penetrations of concrete walls and slabs.

S. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Plastic, Nonpressure-Piping, Solvent-Cemented 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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 CLEANOUTS

A. Floor and Wall Cleanouts
   1. Install at locations shown on the plans and at the base of each leader both inside and outside the building, every 50ft in horizontal piping and at each chance in direction that exceed 135 degrees.
   2. Cleanouts shall be rated to withstand the maximum static pressure generated in the system.

3.5 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in OD's.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."
1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
4. Vertical Piping: MSS Type 8 or Type 42, clamps.
5. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
6. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
7. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
   2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
   3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
   4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
   5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
   6. Spacing for 10-foot (3-m) pipe lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
   7. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
   2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
   3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. **NPS 6 and NPS 8 (DN 150 and DN 200):** 48 inches (1200 mm) with 3/4-inch (19-mm) rod.

5. **NPS 10 and NPS 12 (DN 250 and DN 300):** 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

6. Install supports for vertical PVC piping every 48 inches (1200 mm).

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer’s written instructions.

### 3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

### 3.8 IDENTIFICATION

A. Identify exposed storm drainage piping.

### 3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

2. *Final Inspection:* Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. *Reinspection:* If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. *Reports:* Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested. Partial test shall only be allowed for repairs, alterations or extension. Partial test are not acceptable for new installations.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure for alterations, extensions or repairs: Test the portions of storm drainage piping system involved to nearest existing upstream and downstream cleanouts. Install a test plug in the nearest existing downstream cleanout and fill the piping with water to the point of overflow. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.

4. Test Procedure for new installations: Test the entire storm drainage piping system on completion of roughing-in. Partial tests of individual portions shall not be allowed. Close openings in piping system and fill with water to the point of overflow. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

7. Submit reports to the owner and engineering for review.

8. Where it is impractical to conduct testing as required by this section, consult the authority having jurisdiction for alternate testing methods.

3.10 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.11 PIPING SCHEDULE

A. See drawings for the piping schedule.

END OF SECTION 22 1413
SECTION 22 3300
ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermostat-control, electric, tankless, domestic-water heaters.

1.2 ACTION SUBMITTALS

A. Product Data & Shop Drawings:

1. Electric, tankless, domestic-water heaters.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.4 WARRANTY

A. Materials: 1 year

B. Labor: 1 year

PART 2 - PRODUCTS

2.1 ELECTRIC, TANKLESS, domestic-WATER HEATERS

A. Thermostat-Control, Electric, Tankless, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Chronomite Laboratories, Inc.
b. Stiebel-Eltron

c. Rheem

2. Materials:

a. Cabinet: Powder coated steel
b. Element: Nichrome coils

3. Minimum Operating Flow Rate: 0.35 gpm
4. Minimum water pressure: 25 psi
5. Maximum Operating pressure: 80 psi
6. Maximum operating Temperature: 160F
7. Operating Temperature Range: 70F – 125F
8. Factory Pre-set temperature: 105F

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Electric, Tankless, Domestic-Water Heater Mounting:

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor domestic-water heaters to substrate.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 15 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 15 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 22 3300
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: All plumbing fixtures shown and scheduled on the drawings.

1.2 ACTION SUBMITTALS

A. Product Data: For each fixture and all associated trim.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance data for all products.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURE MANUFACTURERS – In addition to the manufacturer(s) listed on the plumbing fixture schedule on the drawings, the following manufacturers are approved. Manufacturers not listed below must be approved prior to bidding. All plumbing fixtures used on this project shall meet the conditions of quality, performance and aesthetics of the fixtures listed in the Plumbing Fixture Schedule on the Drawings.

A. DRINKING FOUNTAINS & WATER COOLERS
   1. ELKAY
   2. HALSEY TAYLOR
   3. BRADLEY

B. EMERGENCY SHOWERS & EYEWASHES
   1. ACORN SAFETY
   2. BRADLEY
   3. HAWS

C. THERMOSTATIC MIXING VALVES
   1. LEONARD
   2. HAWS
   3. BRADLEY
   4. SYMMONS
   5. ACORN SAFETY

D. FLOOR DRAINS
   1. JR SMITH
   2. ZURN

E. FLOOR SINKS
   1. JR SMITH
2. ZURN

F. HOSE BIBBS
1. WOODFORD
2. ZURN
3. NIBCO

G. LAVATORIES FIXTURES
1. KOHLER
2. AMERICAN STANDARD
3. SLOAN

H. LAVATORY FAUCETS
1. MOEN COMMERCIAL
2. CHICAGO FAUCET
3. ZURN

I. WASH FOUNTAINS
1. BRADLEY
2. ACORN ENGINEERING

J. MOP AND SERVICE SINKS
1. FIAT
2. MUSTEE
3. ZURN

K. MOP AND SERVICE FAUCETS
1. MOEN COMMERCIAL
2. CHICAGO FAUCET
3. T&S BRASS

L. ROOF DRAINS
1. JR SMITH
2. ZURN
3. WATTS

M. ROOF DRAIN DOWN SPOUTS
1. JR SMITH
2. ZURN
3. WATTS

N. STAINLESS STEEL SINKS
1. ELKAY
2. JUST
3. KOHLER
O. SINK FAUCETS
   1. MOEN COMMERCIAL
   2. T&S BRASS
   3. CHICAGO FAUCET

P. SHOWER ENCLOSURES
   1. AQUARIUS
   2. AQUATIC

Q. SHOWER VALVES
   1. SYMMONS
   2. MOEN COMMERCIAL

R. URINALS
   1. KOHLER
   2. AMERICAN STANDARD
   3. SLOAN

S. WATER CLOSETS
   1. KOHLER
   2. AMERICAN STANDARD
   3. SLOAN

T. FLUSH VALVES
   1. MOEN COMMERCIAL
   2. SLOAN
   3. ZURN

2.2 CARRIER AND FIXTURE SUPPORTS
   A. Description: All carrier and fixture supports shall be commercial grade and of the type and style suited for the application. All fixture supports must secure to the floor.

   B. Provide and install carriers or fixture supports for all water closets, urinals, wall-mounted lavatories/sinks.

2.3 FLEXIBLE WATER SUPPLIES
   A. Description: Flexible, braided stainless steel domestic water supply connector.

   B. Maximum Operating Temperature: 140F

   C. Maximum Operating Pressure: 125 psi

   D. Materials:
      1. Inner Hose: Reinforced PVC
      2. Braiding: Stainless Steel Wire
      3. Nuts: Chrome Plated Brass
4. Washers: Rubber
   E. Standards: IAPMO approved, Lead Free

2.4 TUBULAR BRASS DRAIN FITTINGS
   A. Standards: IAPMO compliance
   B. Construction: 17 gauge brass with chrome plating, size per plumbing fixture schedule.

2.5 STOP VALVES
   A. Standards: NSF certified, Lead Free.
   B. Description: quarter turn stop valve for domestic water supply to plumbing fixtures
   C. Construction
      1. Body: Brass
      2. Stem: Brass
      3. Handle: Chrome Plated Zinc
      4. O-Ring: EPDM
   D. Pattern: Angle or Straight

2.6 GROUT
   B. Characteristics: Nonshrink; recommended for interior and exterior applications.
   C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
   D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install plumbing fixtures level and plumb according to roughing-in drawings.
   B. Install floor-mounted water closets on closet flange attachments to drainage piping.
   C. Install counter-mounting fixtures in and attached to casework.
   D. Install pedestal lavatories on pedestals and secured to wood blocking in wall.
   E. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

   1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Comply with valve requirements specified in Section 22 0523 “General-Duty Valves for Plumbing Piping.”
F. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

G. Install toilet seats on water closets.

H. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

I. Install shower flow-control fittings with specified maximum flow rates in shower arms.

J. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.
   2. Exception: Omit trap on indirect wastes unless otherwise indicated.

K. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

L. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install in sink deck. Connect inlet hose to dishwasher and outlet hose to disposer.

M. Set bathtubs and shower receptors in leveling bed of cement grout.

N. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks.

O. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.

P. Seal joints between plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

3.2 CONNECTIONS
A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 1116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 1316 "Sanitary Waste and Vent Piping."

D. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks.

3.3 ADJUSTING
A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.4 CLEANING AND PROTECTION
A. After completing installation of plumbing fixtures, inspect and repair damaged finishes.
B. Clean plumbing fixtures, faucets, and other fittings with manufacturers’ recommended cleaning methods and materials.

C. Provide protective covering for installed plumbing fixtures and fittings.

D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 4100
PART 1 - GENERAL

1.01 MECHANICAL REQUIREMENTS

A. The mechanical requirements are supplemental to the General Requirements of these Specifications. The Mechanical Sections shall apply to phases of the work specified, shown on the Drawings, or required to provide for the complete installation of Mechanical Systems for this project.

B. The work shall include all items, articles, materials, operations and methods listed, mentioned, or scheduled in these specifications and the accompanying drawings. All material, equipment, and labor shall be furnished together with all incidental items required by good practice to provide the complete systems described.

C. Examine and refer to all Architectural, Civil, Structural, Electrical, Utility, Landscape and Mechanical drawings and specifications for construction conditions which may affect the mechanical work. Inspect the building site and existing facilities for verification of present conditions. Make proper provisions for these conditions in performance of the work and cost thereof.

D. See general requirements for listed Alternate Bids. Note alternates listed and include any changes in work and price required to meet the requirements of the respective alternate.

1.02 CODES AND STANDARDS

A. Work shall meet the requirements of the plans and specifications and shall not be less than the minimum requirements of applicable sections of the latest Codes and Standards of the following Organizations:

1. American Gas Association (AGA)
2. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
3. American Society of Mechanical Engineers (ASME)
4. American Water Works Association (AWWA)
5. National Electrical Code (NEC)
6. National Electrical Manufacturers Association (NEMA)
7. National Fire Protection Association (NFPA)
8. Uniform Plumbing Code (UPC)
9. Occupational Safety & Health Act (OSHA)
10. Plastic Pipe Institute (PPI)
11. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
12. International Mechanical Code (IMC)
15. Requirements of the Serving Utility Company
16. Local and State Codes and Ordinances
17. SMACNA Seismic Manual

1.03 FEES AND PERMITS

A. The Mechanical Contractor shall pay all fees and arrange for all permits required for work done under his contract and under his supervision by subcontract.
B. All usage contracts between the Owner and the serving utilities company, such as membership and usage charges or fees, etc., for the purpose of obtaining the services for the utility company shall be applied for and paid for by the Owner.

1.04 MATERIALS AND EQUIPMENT

A. Manufacturer’s trade names and catalog numbers listed are intended to indicate the quality of equipment or materials desired. Manufacturers not listed in the specification will be considered substitutions and must have prior approval.

B. Written prior approval for substitutions must be submitted to and received by the Architect/Engineer ten (10) days prior to bid opening. Requests for substitution are to be submitted sufficiently ahead of the deadline to give ample time for examination. Prior approval request for substitution must indicate the specific item or items to be furnished in lieu of those scheduled, together with complete technical and comparative data on scheduled items and items proposed for substitution.

C. If the engineer approves any proposed substitution, the approved product will be listed in an addendum. Bidders shall not rely on approval made in any other manner.

D. Mechanical equipment may be installed with manufacturer’s standard finish and color except where specific color, finish or choice is indicated. If the manufacturer has no standard finish, equipment shall have a prime coat and two finish coats of gray enamel.

E. High altitude operation: Capacity of all equipment is to be sized and manufactured to perform at the elevation of the project site. If not specifically indicated in the equipment schedule or in the specifications provide all required accessories and equipment for proper operation at elevation of the project site.

F. This Contractor shall be responsible for materials and equipment installed under this contract. Contractor shall also be responsible for the protection of materials and equipment of others from damage as a result of his work.

G. Manufactured material and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by manufacturer unless herein specified to the contrary.

H. This Contractor shall make the required arrangement with Construction Manager for the introduction into the building of equipment too large to pass through finished openings.

I. Store materials and equipment indoors at the job site or, if this is not possible, store on raised platforms and protect from the weather by means of waterproof covers. Coverings shall permit circulation of air around the materials to prevent condensation of moisture. Screen or cap openings in equipment to prevent the entry of vermin.

1.05 INTENT OF DRAWINGS

A. The drawings are partly diagrammatic and do not necessarily show exact location of piping and ductwork unless specifically dimensioned. Risers and other diagrams are schematic and do not necessarily show the physical arrangement of the equipment. They shall not be used for obtaining lineal runs of piping or ductwork, nor shall they be used for shop drawings for piping and ductwork fabrication or ordering. Discrepancies shown on different plans, or between plans and actual field conditions shall be brought to the attention of the Architect/Engineer for resolution.
1.06 RESPONSIBILITY

A. The Mechanical Contractor shall be responsible for the installation of a satisfactory and complete system in accordance with the intent of the drawing and specifications. Provide, at no extra cost, all incidental items, materials, accessories and labor required for completion of the work even though they are not specifically mentioned or indicated on the drawings or in the specifications.

B. The drawings do not attempt to show complete details of the building construction which affect the mechanical installation; and reference is therefore required to the Architectural, Civil, Structural, Landscape and Electrical drawings and specifications and to shop drawings of all trades for additional details which affect the installation of the work covered under this Division of the Contract.

C. Location of mechanical system components shall be checked for conflicts with openings, structural members and components of other systems having fixed locations. In the event of any conflicts, the Architect/Engineer shall be consulted and his decision shall govern. Necessary changes shall be made at the Contractor's expense.

D. Determine, and be responsible for, the proper location and character of inserts for hangers, chases, sleeves, and other openings in the construction required for the work, and obtain this information well in advance of the construction progress so work will not be delayed.

E. Final location of inserts, hangers, etc., required for each installation, must be coordinated with facilities required for other installations to prevent interference.

F. Take extreme caution not to install work that connects to equipment until such time as complete Shop Drawings of such equipment have been approved by the Architect/Engineer. Any work installed by the Contractor, prior to approval of Shop Drawings, will be at the Contractor's risk.

G. All modifications and changes required due to installation of substituted equipment shall be made at the contractor's expense.

H. It shall the responsibility of the installing contractor to coordinate changes to work by other trades that result from the installation of equipment other than the scheduled equipment.

I. If the provided equipment is heavier or larger than the scheduled or specified equipment, it shall be the responsibility of the installing contractor to coordinate the required structural changes and pay for any and all associated cost.

J. If the provided equipment has different motor characteristics or electrical requirements than the scheduled or specified equipment, it shall be the responsibility of the installing contractor to coordinate the required changes and pay for any and all associated cost.

K. If larger or additional electrical conduits are required due to the installation of equipment other than the scheduled or specified equipment it shall be the responsibility of the installing contractor to coordinate the required changes and pay for any and all associated cost.

L. If the provided equipment requires different fluid flow rates than the scheduled or specified equipment, it shall be the responsibility of the installing contractor to coordinate all required changes including but not limited to pumps, piping, valves, etc and pay for any and all associated cost.

M. At all times during the performance of this Contract, properly protect work from damage and protect the Owner's property from injury of loss. Make good any damage, injury or loss, except
such as may be directly due to errors in the Bidding Documents or caused by Agents or Employees of the Owner. Adequately protect adjacent property as provided by law and the Bidding Documents. Provide and maintain passageways, guard fences, lights and other facilities for protection required by Public Authority or Local conditions.

N. The Contractor shall be responsible for damages due to the work of their contractors, to the building or its contents, people, etc.

1.07 REVIEW

A. All work and material is subject to review at any time by the Architect/Engineer or his representative. If the Architect/Engineer or his representative finds material that does not conform to these specifications or that is not properly installed or finished, correct the deficiencies in a manner satisfactory to the Architect/Engineer at the Contractor's expense.

1.08 WORKMANSHIP

A. GENERAL

1. Work under this contract shall be performed by workmen skilled in the particular trade, including work necessary to properly complete the installation in a workmanlike manner to present a neat and finished appearance.

B. CUTTING, PATCHING, AND FRAMING

1. Obtain Architect's/Engineer's approval before performing any cutting on structural members or patching of building surfaces. Any damage to the building or equipment by this Contractor shall be the responsibility of this Contractor and shall be repaired by skilled craftsmen of the trades involved at the Contractor's expense.

2. Chases, openings, sleeves, hangers, anchors, recesses, equipment pads, framing for equipment, provided by others only if so noted on the drawings. Otherwise, they will be provided by this Contractor for his work. Whether chases, etc., are provided by this Contractor or others, this Contractor is responsible for correct size and locations.

1.09 COORDINATION

A. This Contractor shall plan his work to proceed with a minimum interference with other trades and it shall be his responsibility to inform the General Contractor of all openings required in the building structure for installation of work, and to provide sleeves as required. Dimensions of equipment installed and/or provided by others shall be checked in order that correct clearances and connections may be made.

B. In general, pipelines requiring gravity drainage shall be installed first, followed by ductwork, large piping mains and electrical conduit. The location fire protection piping and heads shall be coordinated with other trades to ensure that installations by other trades do not block heads.

C. Leave sufficient space for the installation of insulation on piping and ductwork as specified. It is not acceptable to compress pipe or duct insulation for any reason.

1.10 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish caused by his work or employees.
B. Upon completion of work, remove materials, scraps and debris relative to his work and leave the premises, including tunnels, crawl spaces, and pipe chases in clean and orderly condition. Remove all dirt and debris from the interior and exterior of all devices and equipment. After construction is completed, wash all mechanical equipment.

1.11 DUST PROTECTION

A. Contractor will provide suitable dust protection for all existing areas prior to beginning of cutting or demolition. Contractor will obtain approval of partition from Owner before proceeding with work involved in these rooms.

1.12 TEMPORARY FACILITIES

A. OFFICES

1. Contractor may provide a temporary office for himself and for the periodic use by the Architect/Engineer.

B. REMOVAL

1. Contractor shall completely remove his temporary installations when no longer needed and the premises shall be completely clean, disinfected, patched, and refinished to match adjacent areas.

C. LADDERS AND SCAFFOLDS

1. The Contractor shall provide their own ladders, scaffolds, etc. of substantial construction for access to their work in various portions of the building as may be required. When no longer needed, they shall be removed by the Contractor.

D. PROTECTION DEVICES

1. The Contractor shall provide and maintain his own necessary barricades, fences, signal lights, etc., required by all governing authorities or shown on the drawings. When no longer needed, they shall be removed by the Contractor. The Contractor shall assume all responsibility for which the Owner may be held responsible because of lack of above items.

E. TEMPORARY FIRE PROTECTION

1. The Contractor shall provide all necessary first aid hand fire extinguishers for Class A, B, C and special hazards as may exist in his own work area only in accordance with good and safe practice and as required by jurisdictional safety authority. The Contractor shall provide general area fire extinguishers only.

1.13 SHOP DRAWINGS

A. Submittal Schedule:

1. Prior to submitting any submittals, the mechanical contractor shall provide a schedule of all submittals. The schedule shall indicate the following:

   a. Specification Section
   b. Equipment/Material Name or Mark
c. Submittals Type Required: Product Data, Shop Drawing, Delegated Design, O&M Data

B. Submittals will be required for each item of material and equipment furnished as noted in specifications.

C. All mechanical submittals shall be electronic and submitted in PDF format. If multiple specifications are included in a submittal, combine all information including transmittal information shall be combined into one file.

D. Shop drawings and literature shall be complete clearly show item used, size, dimensions, capacity, rough in, etc., as required for complete check and installation. Manufacturer’s literature showing more than one item shall be clearly marked as to which item is being furnished or it will be rejected and returned without review.

E. Each copy of each item submitted must be clearly marked as follows for purposes of identification and record. Submittals not marked (typewritten only) as described below will be rejected and returned without review.

F. Date:

G. Name of Project:

H. Branch of Work:

I. Submitted by:

J. Specification or Plan Reference:

K. Prior to their submission, each submittal shall be thoroughly checked by the Contractor for compliance with the Contract Document requirements, accuracy of dimensions, relationship to the work of other trades, and conformance with sound, safe practices as to erection and installation. Each submittal shall then bear a stamp evidencing such checking and shall show corrections made, if any. Submittals requiring extensive corrections shall be revised before submission. Each submittal not stamped and signed by the Contractor evidencing such checking will be rejected and returned without review.

L. All submittals will be examined when submitted in proper form for compliance. Such review shall not relieve the Contractor of responsibility for errors, for deviation from the contract Documents, nor for violation of sound safety practices.

M. The Contractor shall keep in the field office one print of each submittal which has been reviewed and stamped by the Architect or Engineer.

N. Submittals which are incomplete relative to quality requirements, capacity, engineering data, dimensional data or detailed list of specialty or control equipment will be rejected. Lists shall include descriptive coding as specified or shown on drawings.

O. THE ENGINEER WILL PERFORM SHOP DRAWING REVIEW OF EACH ITEM; HOWEVER, SUBSEQUENT REVIEW OF ITEMS PREVIOUSLY REJECTED WILL BE BILLED TO THE CONTRACTOR AT A RATE OF $110 PER HOUR.

P. Review of the shop drawings and literature by the engineer shall not relieve the contractor for responsibility for deviations for the drawings or specifications, nor shall it relieve the contractor from responsibility for errors in the shop drawings or literature. It is the responsibility of the
contractor to provide materials and equipment which meet the specifications and job requirements.

1.14 OPERATION AND MAINTENANCE MANUALS

A. At the time orders are placed for any item of equipment requiring service or operating maintenance, the Contractor shall request the manufacturer furnish three (3) copies of OPERATION AND MAINTENANCE INSTRUCTIONS for each piece of equipment. These shall be included in the brochure of equipment.

1.15 BROCHURE OF EQUIPMENT

A. Upon completion of work, prepare three copies of "Brochure of Equipment" containing data pertinent to equipment and systems on job. Binders containing materials shall be one or more three ring binders of sufficient number to hold all literature. Contained in binders shall be: Installation, maintenance, and operating instructions for each piece of equipment; parts lists; wiring diagrams; one copy of each shop drawing and literature submittal; record drawings, etc.

B. All literature shall be clean, unused and filed under divider headings corresponding to the specifications.

C. These brochures shall be submitted to the Architect/Engineer and approved by him before authorization of final payment.

1.16 AS BUILT DRAWINGS

A. The Contractor shall furnish to the Owner and Architect/Engineer a marked print showing the location of all concealed or underground pipe or conduit runs and other equipment installed other than as shown on the drawings. Dimension underground lines from established building lines. Indicate all installed pull boxes in conduit runs.

B. The Contractor shall furnish to the Architect/Engineer a marked print showing the location of all mechanical equipment, plumbing fixtures, piping, ductwork, diffusers, grilles, etc. The location of any item which deviates from the bid documents shall be accurately drawn and dimensioned.

C. All underground piping and ductwork shall be dimensioned from nearest column and/or exterior walls. The location of all maintenance related items such as duct access doors, fire dampers, isolation valves, filters, etc., shall be highlighted on as built drawing.

1.17 PLACING SYSTEMS IN OPERATION

A. Start-up of all HVAC equipment shall be completed by factory trained representatives. At the completion of start-up, the factory representative shall submit to the architect and engineer, a start-up report that indicates any problems encountered, potential problems including installation issues, adjustments made or required to be made to ensure proper operation.

B. At the completion of the work and at such time as the Owner shall direct, prior to final acceptance, the Contractor performing this work shall put into satisfactory operation the various systems installed under the specifications. At no additional cost to the Owner, furnish the services of a person completely familiar with the installations performed under this specification, to instruct the Owner’s operating personnel in the proper operation and servicing of the equipment and systems. These services shall be available for a period of no less than one (2) days.
C. All filters in air handling equipment shall be replaced with new clean filters prior to final acceptance.

1.18 WARRANTY

A. The Contractor shall guarantee that all materials and labor installed are new and of first quality and that any material or labor found defective shall be replaced without cost to the Owner within one (1) year after substantial completion of the Contract or one (1) full season of heating and cooling operation, whichever is the greater. The guarantee shall list the date of the beginning of the one (1) year period, which shall be the date that the Substantial Completion Certificate is issued.

B. Any damage to the building, caused by defective work or material of the Contractor within the above-mentioned period, shall be satisfactorily repaired without cost to the Owner.

C. The guarantee does not include maintenance of equipment. The Owner shall accept full responsibility for proper operation and maintenance of equipment immediately upon substantial completion and occupancy of the building.

D. Final acceptance by the Owner will not occur until all operating instructions are mounted in Equipment Rooms and Operating Personnel thoroughly indoctrinated in the operation of all mechanical equipment by the Contractor.

E. No equipment installed as part of this project shall be used for temporary heat during construction.

END OF SECTION
SECTION 23 0516
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

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. Section Includes:
   1. Rubber, Expansion-Compensator Packless Expansion Joints
   2. Flexible-Hose Packless Expansion Joints
   3. Rubber Packless Expansion Joints
   4. Grooved-Joint Expansion Joints
   5. Alignment Guides and Anchors

1.3 PERFORMANCE REQUIREMENTS
A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.
B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
   2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
   3. Alignment Guide Details: Detail field assembly and attachment to building structure.
   4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.5 INFORMATIONAL SUBMITTALS
A. Welding certificates.
B. Product Certificates: For each type of expansion joint, from manufacturer.

1.6 CLOSEOUT SUBMITTALS
A. Maintenance Data: For expansion joints to include in maintenance manuals.
1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

A. Rubber, Expansion-Compensator Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amber/Booth Company, Inc.; a div. of Vibration Isolation Products of Texas, Inc.
   b. Flexicraft Industries.
   c. General Rubber Corporation.
   d. Mason Industries, Inc.; Mercer Rubber Co.
   e. Unisource Manufacturing, Inc.

3. Minimum Pressure Rating: 150 psig at 170 deg F (1035 kPa at 77 deg C) unless otherwise indicated.
4. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
5. End Connections for NPS 2-1/2 and large: Flanged.

B. Flexible-Hose Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Flexicraft Industries.
   b. Flex Pression Ltd.
   c. Metraflex, Inc.
   d. Unisource Manufacturing, Inc.

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.
   a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 340 psig at 450 deg F (2340 kPa at 232 deg C) ratings.
   b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F (4830 kPa at 21 deg C) and 500 psig at 450 deg F (3450 kPa at 232 deg C) ratings.

5. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Carbon-steel fittings with flanged end connections.
   a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F (1380 kPa at 21 deg C) and 145 psig at 600 deg F (1000 kPa at 315 deg C) ratings.
b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F (1900 kPa at 21 deg C) and 200 psig at 600 deg F (1380 kPa at 315 deg C) ratings.

C. Rubber Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amber/Booth Company, Inc.; a div. of Vibration Isolation Products of Texas, Inc.
   b. Flex-Weld, Inc.
   d. Metraflex, Inc.
   e. Red Valve Company, Inc.
   f. Unaflex.
   g. Unisource Manufacturing, Inc.

4. Arch Type: Single or multiple arches with external control rods.
5. Spherical Type: Single or multiple spheres with external control rods.
6. Minimum Pressure Rating for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 150 psig (1035 kPa) at 220 deg F (104 deg C).
7. Minimum Pressure Rating for NPS 5 and NPS 6 (DN 125 and DN 150): 140 psig (966 kPa) at 200 deg F (93 deg C).
8. Material for Fluids Containing Acids, Alkalies, or Chemicals: BR or CSM or EPDM.
9. Material for Fluids Containing Gas, Hydrocarbons, or Oil: Buna-N or CR.

D. Grooved-Joint Expansion Joints

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International, Inc.
   b. Shurjoint Piping Products.
   c. Victaulic Company.

2. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
4. Standard: AWWA C606, for grooved joints.
6. Couplings: 5, 7, 10 or 12 as required for the application, flexible type for steel-pipe dimensions. Include ferrous housing sections, Buna-N gasket suitable for diluted acid, alkaline fluids, and cold and hot water EPDM gasket suitable for cold and hot water, and bolts and nuts.

2.2 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Anvil International Inc.
b. Hyspan Precision Products, Inc.
c. Metraflex, Inc.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
   a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install rubber packless expansion joints according to FSA-NMEJ-702.

C. Install grooved-joint expansion joints to grooved-end steel piping

3.2 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer’s written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 23 0516
SECTION 23 0517
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc
2. CALPICO, Inc
3. Metraflex Company (The)
4. Pipeline Seal and Insulator, Inc
5. Proco Products, Inc

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber or NBR 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.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT


B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.

   1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

   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 (50 mm) above finished floor level.

   2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

   1. Cut sleeves to length for mounting flush with both surfaces.

   2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.

   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

   1. Exterior Concrete Walls above Grade:
      a. Galvanized-steel wall sleeves.

   2. Exterior Concrete Walls below Grade:
a. Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Galvanized-steel-pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Galvanized-steel-pipe sleeves.

5. Interior Partitions:

a. Galvanized-steel-pipe sleeves.

END OF SECTION 23 0517
SECTION 23 0519
METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Bimetallic-actuated thermometers.
   2. Thermowells.
   3. Dial-type pressure gages.
   4. Gage attachments.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Thermometers
   2. Thermowells
   3. Pressure Gages
   4. Pressure Gage Attachments

B. INFORMATIONAL SUBMITTALS

C. Product certificates.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ernst Flow Industries
   2. Trerice, H. O. Co.
   3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   4. Weiss Instruments, Inc.


C. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch (76-mm) nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F (deg C).

E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

F. Connector Size: 1/2 inch (13 mm), with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch (6.4 or 9.4 mm) in diameter; stainless steel.
H. Window: Plain glass.
I. Ring: Stainless steel.
J. Element: Bimetal coil.
K. Pointer: Dark-colored metal.
L. Accuracy: Plus or minus 1 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:
   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 or CSA.
   5. Type: Stepped shank unless straight or tapered shank is indicated.
   6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
   7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
   8. Bore: Diameter required to match thermometer bulb or stem.
   9. Insertion Length: Length required to match thermometer bulb or stem.
   10. Lagging Extension: Include on thermowells for insulated piping and tubing.
   11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ernst Flow Industries.
      b. Trerice, H. O. Co.
      c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
      d. Weiss Instruments, Inc.
   3. Case: Liquid-filled Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
   4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
   5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
   6. Movement: Mechanical, with link to pressure element and connection to pointer.
   7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
   9. Window: Glass or plastic.
   10. Ring: Metal.
11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), 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 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install valve and snubber in piping for each pressure gage for fluids.

I. Install thermometers in the following locations:

   1. Inlet and outlet of each boiler.
   2. Inlets and outlets of each water heat exchanger.
   3. Inlet and outlet of each hot-water storage tank.
   4. Inlet and outlet of each water chiller.

J. Install pressure gages in the following locations:

   1. Suction and discharge of each water pump.

K. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

L. Adjust faces of meters and gages to proper angle for best visibility.

3.2 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each boiler shall be the following:

   1. Liquid-filled Sealed, bimetallic-actuated type.
B. Thermometers at inlets and outlets of each water heat exchanger shall be the following:
   1. Liquid-filled Sealed, bimetallic-actuated type.

C. Thermometers at inlet and outlet of each hot-water storage tank shall be the following:
   1. Liquid-filled Sealed, bimetallic-actuated type.

D. Thermometers at inlet and outlet of each water chiller shall be the following:
   1. Liquid-filled Sealed, bimetallic-actuated type.

E. Thermometer stems shall be of length to match thermowell insertion length.

3.3 THERMOMETER SCALE-RANGE SCHEDULE
A. Scale Range for Heat Pump - Water Piping: 0 to 180 deg F.

3.4 PRESSURE-GAGE SCHEDULE
A. Pressure gages at suction and discharge of each water pump shall be the following:
   1. Liquid-filled Sealed, direct-mounted, metal case.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE
A. Scale Range for Heat Pump - Water Piping: 0 to 100 psi (0 to 600 kPa).

END OF SECTION 23 0519
SECTION 23 0520
BTU METERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. BTU Meters

1.02 ACTION SUBMITTALS

A. Product Data:
   1. Magnetic Flow Meters
   2. Matched Temperature Sensors
   3. Btu Computers

1.03 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.04 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Provide flow type electromagnetic meters as manufactured by Badger Meter, Inc. All other manufacturers seeking to bid shall provide written request for approval a minimum of 10 days prior to the bid date. Provide with the request a complete submittal with all information noted in the following specification clearly indicated. All incomplete requests will be rejected.

B. Flow meters and BTU computers shall be manufactured by the same company.

C. All meters and BTU computers shall provide a compatible signal to MUS's smart metering system. Any manufacturer requesting approval shall guarantee in writing that the output signal will be compatible.

D. Badger meters are supplied by IES Sales, Inc. Contact Mike Geddes at (406)245-1144

E. It shall be the responsibility of the mechanical contractor to coordinate the integration the BTU meter installed as part of this project into MSU's smart metering system. Include all labor and materials required including programming and modifications to the campus smart metering system (Square D Ion Enterprise).

2.02 CONSTRUCTION

A. Provide BTU meters as listed in the schedule and as described herein.

B. Meter housing shall be constructed of welded carbon steel. Pipe spool material shall be 316 stainless steel. Flanges shall be carbon steel meeting ANSI B16.5, Class 150 RF, 125 pound with 4 bolt pattern. All meters shall be lined with PTFE liner rated for 300°F.
C. Provide with three measuring electrodes.

D. Flow meter shall have a flow accuracy of +/-0.25% at velocities greater than 1.64 ft/s, independent of fluid viscosity, density and temperature. Repeatability shall be +/- 0.1%.

E. Coil power shall be pulsed DC. Cable entries shall be 1/2" NTP cord grip. Meter enclosure shall be rated at NEMA 4X. The junction box for the remote amplifier shall be powder coated die cast aluminum, NEMA 4.

2.03 AMPLIFIER

A. Amplifier shall be rated for 120 volt, 60 Hz AC power.

B. Provide all remote amplifiers with factory supplied cable between the flow meter and the amplifier. Install in conduit as required to pull the factory cable. Provide length to match installation, minimum length, 30 feet. Field verify if additional length is required.

C. Processor shall be 32-bit DSP.

D. The amplifier shall be provided with the following outputs as a minimum:
   1. Digital Outputs: Provide four configurable outputs, (2) 24 VDC sourcing active output, 100mA total, 50mA each; (4) sinking open collector outputs, 30 VDC Max, 100 mA each; or (2) AC solid-state relay, 48 VAC, 500 mA max. Digital outputs shall programmable to provide the following:
      a. Flow Pulse Output: Scalable up to 10 kHz, passive open collector up to 10 kHz, active switched 24 VDC. Pulse width programmable from 1-1,000 ms or 50 percent duty cycle. Pulse outputs shall be compatible with the BTU computers. Pulse output shall be programmable for flow direction.
      b. 24 VDC supply output.
      c. Empty pipe alarm.
      d. Error alarm or high/Low flow Alarm (0-100% of flow).
   2. Analog Outputs: 4-20 mA, 0-20 mA, 0-10 mA, 2-10 mA, programmable and scalable, voltage sourced 24 VDC, isolated with maximum loop resistance < 800 ohms. Provide for future connection to energy management system or remote readout for transmitting flowrate and/or totalizing information
   3. Communications Output: Provide with RS232 configurable Modbus RTU or RDI output for possible future connection to EMS system for transmitting flowrate and/or totalizing information
   4. Units of Measure available in the system: pounds, liters, US gallon, cubic meters and cubic feet. These shall be programmable in the unit. Initial programming shall be in multiples of pounds and pounds/minute for condensate meters and multiples of gallons and gallons/minute for heating water systems.

E. Provide with LCD display with 4x20 character display with back light. Programming shall be accomplished via 3-buttons on face of panel. Display shall show fluid flow rate and totalized flow.

F. Provide with solid state, non-volatile memory to maintain all data and system programming in the event of a power outage.

2.04 BTU COMPUTER

A. Provide a BTU computer where shown on the plans. Provide for all heating water systems. Provide each BTU meter with two RTD three or four wire temperature sensors and associated
inputs. BTU Computer shall accept the two temperature inputs and the flow input from the flow meter amplifier. Accuracy shall be +/- 3% of total BTU’s at an ambient temperature of 100°F.

B. Provide with NEMA 4x enclosure. Provide for panel face installation. Provide with 120v to 12-24 VAC power transformer rated for the unit power consumption, minimum 15 VA. See below for control panel cabinets. Install BTU Computer in the face of the control panel cabinet. Install transformer and amplifier (where amplifier is remote) in the panel. Provide flex wiring to the BTU Computer to allow panel to be opened.

C. Outputs shall be in energy rate units such as BTU/hr or multiples and energy totalizing outputs shall be in BTU or multiples. Temperature indication shall be in degrees Fahrenheit.

D. Provide with scalable pulse output, dry contacts to communicate with the Square-D equipment. The pulse output shall be a non-powered, dry contact. In addition, provide analog output, USB communication and RS-485 communication for programming and possible future connection to an automation system for transmitting flowrate and/or totalizing information.

E. Provide with programming kit including software for programming the BTU computer. Provide a copy of the software to the owner at the completion of the project.

F. Provide with solid state, non-volatile memory to maintain all data and system programming in the event of a power outage.

2.05 ACCESSORIES

A. Provide two 100 Ohm platinum RTD 3-wire matching temperature sensors and thermowell for each hot water BTU meter. Provide thermo well and sensor matched for pipe size and pipe materials. Provide brass well for copper piping and stainless steel for steel piping.

B. Sensors shall be precision matched, bath calibrated for each meter. Sensors shall meet ASTM E1137 Class A tolerance, +/-0.05% @ 32°F. Sensors shall have a system differential temperature accuracy of +/- 0.10°F or better. Calibrate the sensors at the end of the project for space temperature, fluid temperature, fluid type and sensor cable length.

C. Install each sensor with 10’ of metal flex conduit to allow removal from the well and extension to the floor for future ice bath calibration.

D. Provide steel control panel cabinets with hinged door and twist lock latch. Provide minimum 16”x16”, 6” deep, panels. Provide with powder coated finish. Provide grommets at each wiring penetration.

PART 3 - EXECUTION

3.01 GENERAL

A. Install all meters and equipment per manufacturer’s instructions.

B. Maintain all manufacturer’s required straight piping lengths before and after the meters.

C. Provide and install all interconnecting cables between flow meters, remote amplifiers, temperature sensors and low voltage transformers.

D. Provide all power wiring as noted on the drawings.
E. Install thermo-well in existing piping with new weldolet or new pipe tee.

3.02 START-UP

A. Include in the bid the cost to provide complete factory start-up and programming of all BTU Meters. Install all meters and wiring. Prior to powering on the units, provide factory trained start-up of the meters to verify proper wiring, connections and programming.

B. Calibrate each meter and accessories to account for space temperature, fluid temperatures, connector cable and sensor cable length and fluid type.

C. Test outputs to confirm compatibility with Square D electrical meters. Provide a letter at the completion of the project.

END OF SECTION
SECTION 23 0523
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Bronze ball valves.
   2. Iron, single-flange butterfly valves.
   4. Iron swing check valves.

B. Related Sections:
   1. Section 23 0553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.2 ACTION SUBMITTALS

A. Product Data: None Required

1.3 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

B. Valve Sizes: Same as upstream piping unless otherwise indicated.

C. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
   1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Red-White Valve Corporation.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   b. SWP Rating: 150 psig (1035 kPa).
   c. CWP Rating: 600 psig (4140 kPa).
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Bronze.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. DeZurik Water Controls.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
   d. Red-White Valve Corporation.
   e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 150 psig (1035 kPa).
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One- or two-piece stainless steel.
   g. Disc: Aluminum bronze.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Valve, Inc.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
   d. Red-White Valve Corporation.
   e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig (1380 kPa).
   c. Body Design: Horizontal flow.
   e. Ends: Threaded.
   f. Disc: Bronze.

2.5 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Milwaukee Valve Company.
   b. NIBCO INC.
   c. Red-White Valve Corporation.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-71, Type I.
   b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
   c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
   d. Body Design: Clear or full waterway.
   e. Body Material: ASTM A 126, gray iron with bolted bonnet.
   f. Ends: Flanged.
   g. Trim: Bronze.
   h. Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.
3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or butterfly valves.
2. Pump-Discharge Check Valves:
   a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze disc.
   b. NPS 2-1/2 (DN 65) and Larger: Iron swing check valves with lever and weight or with spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Provide valves with the following end connections:
   1. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
   2. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends

END OF SECTION 23 0523
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Pipe Hangers
2. Trapeze Pipe Hangers
3. Thermal Insulation Shield

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
   3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
   4. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
      b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
      c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
      d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
   5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
   6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.
3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use copper-plated pipe hangers and carbon steel attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb (340 kg).
   b. Medium (MSS Type 32): 1500 lb (680 kg).
   c. Heavy (MSS Type 33): 3000 lb (1360 kg).
8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 0529
SECTION 23 0548
VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. 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. Restraining braces and cables.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.

   a. Component Importance Factor:

      1) Ductwork and HVAC Equipment: 1.0
      2) Fuel Gas Piping: 1.5

   b. Component Response Modification Factor: Per ASCE 7-10
   c. Component Amplification Factor: Per ASCE 7-10

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.722g
4. Design Spectral Response Acceleration at 1-Second Period: 0212g

1.3 ACTION SUBMITTALS

A. Product Data: For each product indicated.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Welding certificates.

C. Field quality-control test reports.
1.5 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved 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.

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. Mason Industries.

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.

1. Resilient Material: Oil- and water-resistant neoprene.

C. 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.

D. 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.

E. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- (13-mm-) 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 (3.45 MPa) and for equal resistance in all directions.

2.2 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. Cooper B-Line, Inc.; a division of Cooper Industries.
3. Hilti, Inc.

B. 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.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

H. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. For Seismic Design Category A or B (regardless of importance factor), no seismic requirements exist for non-structural systems on this project.

B. For Seismic Design Category C with an importance factor Ip = 1.0, no seismic requirements exist for non-structural systems on this project. However, systems, equipment, or piping may still have an Ip = 1.5.
C. For Seismic Design Category C with an importance factor Ip = 1.5:

1. In accordance with the International Building Code and ASCE 7, the following piping, ductwork, or equipment is exempt from seismic controls:
   a. Black iron pipe with threaded joints – NOT exempt per code.
   b. PVC/CPVC pipe – NOT exempt per code.
   c. Highly-deformable piping (copper, black iron w/ welded joints or victaulic joints, PEX, cast iron no-hub): piping 2” and smaller is exempt if hung on individual clevis hangers where provisions are made to protect the piping from impact or to avoid the impact of larger piping or other mechanical equipment.
   d. Hanging, wall mounted, and flexibly supported mechanical and plumbing components that weigh 20 pounds or less, and flexible connections are provided between the components and associated ductwork or piping, are exempt.
   e. Piping supported by individual clevis hangers where the distance, as measured from the top of pipe to the supporting structure, is less than 12 inches for the entire pipe run and the pipe can accommodate the expected deflections, are exempt. Trapeze hung piping is exempt where the distance from the top of the trapeze or support to the structure is less than 12 inches for the entire run. Hanger rods shall not be constructed in a manner that would subject the rod to bending moments (swivel, eye bolt, or vibration isolated hanger connections to structure).
   f. HVAC ducts suspended from hangers that are 12 inches or less in length from the top of the duct to the supporting structure are exempt where the hangers are detailed to avoid significant bending of the hangers and their connections.
   g. HVAC ducts that have a cross-sectional area of less than 6 square feet are exempt.
   h. Equipment installed in-line with the duct system (e.g. fans, heat exchangers, humidifiers, terminal boxes) with an operating weight less than 76 pounds are exempt.

D. For Seismic Design Category D with an importance factor Ip = 1.0:

1. In accordance with the International Building Code and ASCE 7, the following piping, ductwork, or equipment is exempt from seismic controls:
   a. Black iron pipe with threaded joints – NOT exempt per code. Refer to exemption below for distribution systems less than 10 lbs/ft.
   b. PVC/CPVC pipe – NOT exempt per code. Refer to exemption below for distribution systems less than 10 lbs/ft.
   c. Piping and ductwork distribution systems weighing 10 lbs/ft or less are exempt where flexible connectors are provided between the component and the piping or ductwork.
   d. Mechanical components weighing 400 lbs or less and installed at 4 ft above the floor or less are exempt where flexible connectors are provided between the component and the associated piping or ductwork.
   e. Highly-deformable piping (copper, black iron w/ welded joints or victaulic joints, PEX, cast iron no-hub): piping 3” and smaller is exempt if hung on individual clevis hangers where provisions are made to protect the piping from impact or to avoid the impact of larger piping or other mechanical equipment.
   f. Hanging, wall mounted, and flexibly supported mechanical and plumbing components that weigh 20 pounds or less, and flexible connections are provided between the components and associated ductwork or piping, are exempt.
   g. Piping supported by individual clevis hangers where the distance, as measured from the top of pipe to the supporting structure, is less than 12 inches for the entire pipe run and the pipe can accommodate the expected deflections, are exempt. Trapeze hung piping is exempt where the distance from the top of the trapeze or
support to the structure is less than 12 inches for the entire run. Hanger rods shall not be constructed in a manner that would subject the rod to bending moments (swivel, eye bolt, or vibration isolated hanger connections to structure).

h. HVAC ducts suspended from hangers that are 12 inches or less in length from the top of the duct to the supporting structure are exempt where the hangers are detailed to avoid significant bending of the hangers and their connections.

i. HVAC ducts that have a cross-sectional area of less than 6 square feet are exempt.

j. Equipment installed in-line with the duct system (e.g. fans, heat exchangers, humidifiers, terminal boxes) with an operating weight less than 76 pounds are exempt.

E. For Seismic Design Category D with an importance factor Ip = 1.5:

1. In accordance with the International Building Code and ASCE 7, the following piping, ductwork, or equipment is exempt from seismic controls.

   a. Black iron pipe with threaded joints – NOT exempt per code.
   b. PVC/CPVC pipe – NOT exempt per code.
   c. Highly-deformable piping (copper, black iron w/ welded joints or Victaulic joints, PEX, cast iron no-hub): piping 1” and smaller is exempt if hung on individual clevis hangers where provisions are made to protect the piping from impact or to avoid the impact of larger piping or other mechanical equipment.
   d. Hanging, wall mounted, and flexibly supported mechanical and plumbing components that weigh 20 pounds or less, and flexible connections are provided between the components and associated ductwork or piping, are exempt.
   e. Piping supported by individual clevis hangers where the distance, as measured from the top of pipe to the supporting structure, is less than 12 inches for the entire pipe run and the pipe can accommodate the expected deflections, are exempt. Trapeze hung piping is exempt where the distance from the top of the trapeze or support to the structure is less than 12 inches for the entire run. Hanger rods shall not be constructed in a manner that would subject the rod to bending moments (swivel, eye bolt, or vibration isolated hanger connections to structure).
   f. HVAC ducts suspended from hangers that are 12 inches or less in length from the top of the duct to the supporting structure are exempt where the hangers are detailed to avoid significant bending of the hangers and their connections.
   g. HVAC ducts that have a cross-sectional area of less than 6 square feet are exempt.
   h. Equipment installed in-line with the duct system (e.g. fans, heat exchangers, humidifiers, terminal boxes) with an operating weight less than 76 pounds are exempt.

3.2 The seismic restraint manufacturer shall:

A. Determine seismic restraint layout and sizing per IBC.

B. Provide vibration isolation materials where scheduled later in this specification.

C. Provide pipe flexible connectors where scheduled later in this specification.

D. Provide installation instructions and shop drawings for all materials supplied under this specification.

E. Provide a submittal package including calculations to determine seismic restraint loads resulting from seismic forces per IBC. Calculations shall be certified by licensed engineer in the employ
of the seismic equipment manufacturer with a minimum 5 years experience. Calculations and restraint device submittal drawings shall specify anchor bolt type, embedment, concrete compressive strength, minimum spacing between anchors, and minimum distances of anchors to concrete edges.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. 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.

G. 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. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

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 Division 15 Section "Hydronic Piping" for piping flexible connections.
3.5  FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   2. Schedule test with Owner, through Engineer, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
   4. Test at least four of each type and size of installed anchors and fasteners selected by Engineer.
   5. Test to 90 percent of rated proof load of device.
   7. Measure isolator deflection.
   8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.6  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.

3.7  HVAC VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. Equipment:
   1. Boilers.
   2. Pumps.
   3. Chillers.
   4. Expansion Tanks.
   5. Chemical Feed Equipment.
   6. Air Handling Units.
   7. Terminal Boxes.
   8. Unit Heaters.
   9. Air Cooled Condensing Units.

B. Piping:
   1. All piping as required in the Design Category and Importance factor listed above.
   2. All piping within 20 feet of a pump.
C. Ductwork:

1. All ductwork as required in the Design Category and Importance factor listed above.

END OF SECTION 23 0548
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Duct labels.
4. Valve Tags
5. Valve Schedule

1.2 ACTION SUBMITTAL

A. Product Data:

1. Equipment labels.
2. Pipe labels.
3. Duct labels.
4. Valve Tags
5. Valve Schedule

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.
2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Seaton Opti-Code or equal.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.3 DUCT LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-adhesive Duct labels: Seton Opti-Code or equal.

C. Duct Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4 mm) letters for piping system abbreviation and 1/2-inch (13 mm) numbers, with numbering scheme approved by Engineer. Provide 5/32-inch (4 mm) hole for fastener.

1. Material: 0.032-inch (0.8-mm) thick brass or aluminum.
2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

2.5 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: Glazed display frame for removable mounting on walls for each page of valve schedule. Include mounting screws.
2. Frame: Extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5 mm, single-thickness glass.
PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.

B. Pipe Label Color Schedule:

1. Heat Pump - Water Piping:
   a. Background Color: Blue.
   b. Letter Color: White

2. Heating Water Piping:
   a. Background Color: Yellow.
   b. Letter Color: Black.

3. Refrigerant Piping:
   a. Background Color: Blue.

3.4 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system. Do not install duct labels on exposed ductwork.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

1. Valve-Tag Size and Shape: (38 mm).
2. Valve-Tag Color: Natural Brass or Aluminum.

3.6 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location in each major equipment room.

3.7 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedule

END OF SECTION 23 0553
SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
   a. Constant-volume air systems.
   b. Variable-air-volume systems.

2. Balancing Hydronic Piping Systems:
   a. Constant-flow hydronic systems.
   b. Variable-flow hydronic systems.

3. Verification of Temperature Control Sequences.

1.2 DEFINITIONS


C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB, TABB, or as approved by the Engineer prior to bidding.

B. Certify TAB field data reports and perform the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.


D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."
PART 2 - PRODUCTS (Not Applicable)

A. Companies – the following companies are pre-approved. Companies not listed below must submit for approval prior to bidding the project:

1. RGO, Belgrade, MT

PART 3 - EXECUTION

3.1 PREPARATION

A. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.2 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" ASHRAE 111 NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 15 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.3 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.
C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 23 3113 "Metal Ducts."

3.4 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
   a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:
   a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
   b. Measure static pressure directly at the fan outlet or through the flexible connection.
   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
   a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 15 Sections for air-handling units for
adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.
   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.

3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.5 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.

2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the
designed maximum airflow. Use terminal-unit manufacturer's written instructions to make
this adjustment. When total airflow is correct, balance the air outlets downstream from
terminal units the same as described for constant-volume air systems.

5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the
designed minimum airflow. Check air outlets for a proportional reduction in airflow the
same as described for constant-volume air systems.

a. If air outlets are out of balance at minimum airflow, report the condition but leave
outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and
minimum outdoor airflow.

a. Adjust the fan and balance the return-air ducts and inlets the same as described
for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure
controller at the main supply-air sensing station to ensure that adequate static pressure is
maintained at the most critical unit.

8. Record final fan-performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems
have been adjusted, adjust the variable-air-volume systems as follows:

1. Balance variable-air-volume systems the same as described for constant-volume air
systems.

2. Set terminal units and supply fan at full-airflow condition.

3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the
static-pressure controller. When total airflow is correct, balance the air outlets
downstream from terminal units the same as described for constant-volume air systems.

4. Readjust fan airflow for final maximum readings.

5. Measure operating static pressure at the sensor that controls the supply fan if one is
installed, and verify operation of the static-pressure controller.

6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static
pressure to verify that it is being maintained by the controller.

7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the
designed minimum airflow. Check air outlets for a proportional reduction in airflow the
same as described for constant-volume air systems.

a. If air outlets are out of balance at minimum airflow, report the condition but leave
the outlets balanced for maximum airflow.

8. Measure the return airflow to the fan while operating at maximum return airflow and
minimum outdoor airflow.

a. Adjust the fan and balance the return-air ducts and inlets the same as described
for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have
been adjusted, adjust the variable-air-volume systems as follows:

1. Set system at maximum indicated airflow by setting the required number of terminal units
at minimum airflow. Select the reduced-airflow terminal units so they are distributed
evenly among the branch ducts.
2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
3. Set terminal units at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

   a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Engineer and comply with requirements in Division 15 Section "Hydronic Pumps."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer’s performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated presettings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems’ pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.8 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.9 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer’s name, model number, and serial number.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.10 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.11 PROCEDURES FOR COOLING TOWERS

A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:

1. Measure condenser-water flow to each cell of the cooling tower.
2. Measure entering- and leaving-water temperatures.
3. Measure wet- and dry-bulb temperatures of entering air.
4. Measure wet- and dry-bulb temperatures of leaving air.
5. Measure condenser-water flow rate recirculating through the cooling tower.
6. Measure cooling-tower spray pump discharge pressure.
7. Adjust water level and feed rate of makeup water system.
8. Measure flow through bypass.

3.12 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.13 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.
B. Steam Boilers: Measure and record entering-water temperature and flow and leaving-steam pressure, temperature, and flow.

3.14 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.

3.15 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. Check bearings and other lubricated parts for proper lubrication.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.16 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.17 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Submit two reports for each phase of construction, on when the mechanical system installation is 50% complete and one with the mechanical system installation is 90% complete.

3.18 VERIFICATION OF TEMPERATURE CONTROL SEQUENCES

A. Verify all temperature control sequences.

B. Provide written verification of all sequences.

3.19 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report’s binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:
   1. Pump curves.
   2. Fan curves.
   3. Manufacturers’ test data.
   4. Field test reports prepared by system and equipment installers.
   5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:
   1. Title page.
   2. Name and address of the TAB contractor.
   3. Project name.
   4. Project location.
   5. Architect’s name and address.
   6. Engineer’s name and address.
   7. Contractor’s name and address.
   9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
      a. Indicated versus final performance.
      b. Notable characteristics of systems.
      c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer’s name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans and pump performance forms including the following:
      a. Settings for outdoor-, return-, and exhaust-air dampers.
      b. Conditions of filters.
      c. Cooling coil, dry-bulb conditions.
      d. Face and bypass damper settings at coils.
      e. Fan drive settings including settings and percentage of maximum pitch diameter.
      f. Settings for supply-air, static-pressure controller.
      g. Other system operating conditions that affect performance.

D. Verification of Temperature Control Sequences: Provide written verification that all temperature control sequences are operating as per the construction documents. Specifically call out any discrepancies.

E. DUCT TESTING – Only Include DUCT TESTING for large systems with medium or higher duct pressures (2”w.g. or higher)

F. Leakage test procedures shall follow the outlines and classifications in the SMANCA HVAC Air Duct Leakage Test Manual.
G. The Owner and mechanical engineer shall select sections of ductwork from each air handling system for duct leakage testing. The sample shall include at lease five transverse joints, typical seams, and access door connections. The sample will include all medium pressure supply ductwork between the air handling unit to within 2’ of the connection to variable air volume terminal units.

H. The Air handling systems shall be tested at 3 inches w.g. and shall meet leakage Class 3.

I. If a section fails to meet allotted leakage level, the contractor shall modify the ductwork to bring it into compliance and shall retest the section until acceptable leakage is demonstrated. One retest shall will be provided by the TAB contractor. The mechanical contractor shall pay the TAB contractor for any additional retesting required.

J. All testing and necessary repairs shall be completed prior to concealment of the ductwork.

3.20 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: Additional TAB work shall be done at the opposite season from the initial work. This work shall consist of verifying opposite season air flows, water flows, and verification of temperature control sequences. The opposite season TAB work shall consist of not less than 12 hours of work. If work exceeds 24 hours, notify the Engineer prior to continuing past 24 hours. In this case additional compensation may be authorized.

END OF SECTION 23 0593
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following duct services:
   1. Indoor, concealed supply, return, and outdoor air.
   2. Indoor, concealed exhaust between isolation damper and penetration of building exterior.

B. Related Sections:
   1. Section 23 0719 "HVAC Piping Insulation."

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Insulation Materials

1.3 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS


B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin.

   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; SoftTouch Duct Wrap.
b.  Johns Manville; Microlite.
c.  Knauf Insulation; Friendly Feel Duct Wrap.
d.  Owens Corning; SOFTR All-Service Duct Wrap.

F.  Acoustic Duct Liner

1.  Products:  Subject to compliance with requirements, provide one of the following:

   a.  CertainTeed Corp.
   b.  Johns Manville.
   c.  Knauf Insulation.
   d.  Owens Corning.

2.  Description:

   a.  Flexible duct liner made from glass fibers bonded with a thermosetting resin and acrylic coating with a flexible glass mat reinforcement to provide a smooth airstream surface.
   b.  Max air velocity: 6,000 ft/min
   c.  Water repellency – INDA IST 80.6 ≥6
   d.  Fungi resistance – ASTM C1338 Does not breed or promote
   e.  Fungi resistance – ASTM G21 No growth
   f.  Bacteria resistance – ASTM G22 No growth
   g.  Thermal Performance: 1-1/2” thick liner: R-6.3
   h.  Acoustic Performance: NRC 0.85

2.2  ADHESIVES

A.  Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B.  Mineral-Fiber Adhesive:  Comply with MIL-A-3316C, Class 2, Grade A.

   1.  Products:  Subject to compliance with requirements, provide one of the following:

      b.  Eagle Bridges - Marathon Industries; 225.
      d.  Mon-Eco Industries, Inc.; 22-25.

   2.  For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

   3.  Adhesive shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."


   1.  Products:  Subject to compliance with requirements, provide one of the following:

b. Eagle Bridges - Marathon Industries; 225.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.5 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. **Products**: Subject to compliance with requirements, provide one of the following:

   a. ABI, Ideal Tape Division; 491 AWF FSK.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   c. Compac Corporation; 110 and 111.
   d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.6 SECUREMENTS

A. Insulation Pins: Capacitor-discharge-weld pins with washers: 12GA low carbon steel pins with self locking washers. The length of the weld pin shall be coordinated with the thickness of insulation to be installed.
PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

J. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

K. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

L. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere patches similar to butt joints.

3.3 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

1. Comply with requirements in Section 07 8413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 8413 "Penetration Firestopping."

3.4 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install capacitor-discharge-weld pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
   b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Impale insulation over pins and attach speed washers.
   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to two locations for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.6 DUCT INSULATION SCHEDULE

1. See drawings

B. Items Not Insulated:

1. Exposed supply, return and exhaust ducts.
2. Fibrous-glass ducts.
3. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
5. Factory-insulated plenums and casings.
6. Flexible connectors.
8. Factory-insulated access panels and doors.

END OF SECTION 23 0713
**SECTION 23 0719**  
**HVAC PIPING INSULATION**

**PART 1 - GENERAL**

1.1 **SUMMARY**

A. Section includes insulating the following HVAC piping systems:
   1. Heat Pump Water System

1.2 **ACTION SUBMITTALS**

A. Product Data:
   1. Insulating materials
   2. Fitting covers
   3. Field applied jackets

1.3 **INFORMATIONAL SUBMITTALS**

A. Field quality-control reports.

1.4 **QUALITY ASSURANCE**

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

**PART 2 - PRODUCTS**

2.1 **INSULATION MATERIALS**

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Mineral-Fiber, Preformed Pipe Insulation:

   1. **Products**: Subject to compliance with requirements, provide one of the following:
      
      a. *Fibrex Insulations Inc.; Coreplus 1200.*
b. **Johns Manville; Micro-Lok.**
c. **Knauf Insulation; 1000-Degree Pipe Insulation.**
d. **Manson Insulation Inc.; Alley-K.**
e. **Owens Corning; Fiberglas Pipe Insulation.**

2. **Type I, 850 deg F (454 deg C) Materials:** Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

**F. Thermal Insulating Wool:**

1. **Products:** Subject to compliance with requirements, provide one of the following:
   
   a. Owens Corning Fiberglas TIW Type I
   b. Thermafiber Safing
   c. Prior Approved Equal

2. **Type I, 1000 deg F Materials:** Mineral or glass fibers bonded with thermosetting resin. Comply with ASTM C 533, Type I and ASTM C 795.
   
   3. **Thermal Conductivity:** 0.27 btu-in/hr-ft²-F
   4. **Thickness:** Match thickness of adjacent pipe insulation.

**2.2 INSULATING CEMENTS**

A. **Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement:** Comply with ASTM C 449.

1. **Products:** Subject to compliance with requirements, provide one of the following:
   
   a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

**2.3 ADHESIVES**

A. **Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.**

B. **Mineral-Fiber Adhesive:** Comply with MIL-A-3316C, Class 2, Grade A.

1. **Products:** Subject to compliance with requirements, provide one of the following:

   b. Eagle Bridges - Marathon Industries; 225.
   d. Mon-Eco Industries, Inc.; 22-25.

2. **For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).**
3. **Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."**

C. **ASJ Adhesive:** Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. **Products:** Subject to compliance with requirements, provide one of the following:
   b. Eagle Bridges - Marathon Industries; 225.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

**D. PVC Jacket Adhesive:** Compatible with PVC jacket.

1. **Products:** Subject to compliance with requirements, provide one of the following:
   a. Dow Corning Corporation; 739, Dow Silicone.
   d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 **MASTICS**

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastic that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

**B. Vapor-Barrier Mastic:** Water based; suitable for indoor use on below-ambient services.

1. **Products:** Subject to compliance with requirements, provide one of the following:
   b. Vimasco Corporation; 749.

   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

2.5 **SEALANTS**

A. Joint Sealants:
1. **Joint Sealants for Cellular-Glass Products:** Subject to compliance with requirements, provide one of the following:
   b. Eagle Bridges - Marathon Industries; 405.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. **ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:**

1. **Products:** Subject to compliance with requirements, provide one of the following:

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

### 2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. **ASJ:** White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. **ASJ-SSL:** ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

### 2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. **PVC Jacket:** High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. **Products**: Subject to compliance with requirements, provide one of the following:
   a. Johns Manville; Zeston.
   c. Proto Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.

2. **Adhesive**: As recommended by jacket material manufacturer.

3. **Color**: White.

4. **Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.**
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.8 **TAPES**

A. **ASJ Tape**: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. **Products**: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. **Width**: 3 inches (75 mm).
3. **Thickness**: 11.5 mils (0.29 mm).
4. **Adhesion**: 90 ounces force/inch (1.0 N/mm) in width.
5. **Elongation**: 2 percent.
6. **Tensile Strength**: 40 lb/inch (7.2 N/mm) in width.
7. **ASJ Tape Disks and Squares**: Precut disks or squares of ASJ tape.

B. **PVC Tape**: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. **Products**: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.

2. **Width**: 2 inches (50 mm).
3. **Thickness**: 6 mils (0.15 mm).
4. **Adhesion**: 64 ounces force/inch (0.7 N/mm) in width.
5. **Elongation**: 500 percent.
6. **Tensile Strength**: 18 lb/inch (3.3 N/mm) in width.

C. **PVC Tape**: White vapor-retarder PVDC tape with acrylic adhesive.

1. **Products**: Subject to compliance with requirements, provide one of the following:
   a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
2. Width: 3 inches (75 mm).
3. Film Thickness: 6 mils (0.15 mm).
4. Adhesive Thickness: 1.5 mils (0.04 mm).
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lb/inch (10.1 N/mm) in width.

2.9 SECUREMENTS

A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.080-inch (2.0-mm) nickel-copper alloy.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.
H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation and all exposed ends with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe.
      a. For below-ambient services, apply vapor-barrier mastic over all joints and seams.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
   5. Handholes.
   6. Cleanouts.
3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 07 8413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 8413 "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. All piping fittings shall be insulated by filling the total void over all fittings between straight runs of pipe insulation with thermal insulating wool, forming a uniform insulation thickness equal to, or exceeding, the adjacent pipe insulation. Finish all insulated pipe fittings by applying PVC fitting covers overlapping the adjacent pipe insulation outer covering. For
hot service piping, secure the PVC fitting covers stainless steel tack fasteners. For cold service piping, seal the ends of the adjacent pipe insulation with vapor barrier mastic, ensure that the PVC fitting cover overlaps the adjacent pipe insulation jacket by 2” minimum and secure PVC fitting covers to adjacent pipe insulation with 2” wide PVC Tape.

2. Insulate valves with removable insulation jackets. For valves 2” and smaller use “No Sweat” re-usable valve covers or approved equal product. For valves 2-1/2” and larger use removable insulation jackets from Thermaxx or prior approved manufacturer.

3. Insulate strainers with removable insulation jackets. For strainers 2” and smaller use “No Sweat” re-usable valve covers or approved equal product. For strainers 2-1/2” and larger use removable insulation jackets from Thermaxx or prior approved manufacturer.

4. Insulate flanges and unions with removable insulation jackets. For flanges and unions 2” and smaller use “No Sweat” re-usable valve covers or approved equal product. For flanges and unions 2-1/2” and larger use removable insulation jackets from Thermaxx or prior approved manufacturer.

5. PVC fitting covers for grooved piping systems shall be the type designed for use with grooved fittings and couplings to allow sufficient space for the required thickness of insulation.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.5 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer’s recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

2. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVC jacket.

3. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.

4. Jacket shall be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for “fishmouthing,” and use PVC tape along lap seal to secure joint.

5. Repair holes or tears in PVC jacket by placing PVC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

B. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.7 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.8 INDOOR PIPING INSULATION SCHEDULE

A. Heating Water Piping ½" to 1-1/2": Mineral Fiber Pre-Formed 1-1/2" thick
B. Heating Water Piping 2" to 6": Mineral Fiber Pre-Formed 2" thick
C. Heat Pump Water Piping ½" to 1-1/2": Mineral Fiber Pre-Formed 1” thick
D. Heat Pump Water Piping: 2” to 6”: Mineral Fiber Pre-Formed 1-1/2” thick

3.9 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Heat Pump Water Piping ½" to 6": 2” Mineral Fiber Pre-Formed 2” thick

3.10 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Exposed Piping:
   1. PVC

C. Concealed Piping
   1. ASJ

END OF SECTION 23 0719
SECTION 230900

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. See Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each control device indicated.

B. Shop Drawings:
   1. Schematic flow diagrams.
   2. Power, signal, and control wiring diagrams.
   3. Details of control panel faces.
   4. Damper schedule.
   5. Valve schedule.
   A. Retain two subparagraphs below for DDC systems.
   6. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
   7. Control System Software: Schematic diagrams, written descriptions, and points list.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Software and firmware operational documentation.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

C. Unless listed below as approved, all contractors must receive prior-approval to bid from the Engineer.
D. Installing contractor shall be a franchised or direct representative of the control system manufacturer.

E. System shall be that of a contractor who regularly designs, installs and services HVAC temperature control systems as their primary function and must have a history of at least six years in that field.

F. Submittal must present history of the contractor, proof of at least three successful system installations in similar size and usage buildings in the last ten years, qualifications of the installer, qualifications and experience history, setup and test personnel and proof of at least three factory certified permanent maintenance personnel located within 200 miles of job site.

G. The ability of a particular company to install and service equipment and systems will be a consideration in the approval process of systems. The installing contractor shall have operated a permanent office for at least the past two years within 200 miles of the job site. The company shall have not less than three factory certified resident personnel who provide engineering, design, installation, troubleshooting and maintenance services.

H. The contractor shall provide ability to respond in person with factory certified personnel within 24 hours of a service call from the owner, regardless of time of day, day of week, holiday or other factors. The contractor shall also demonstrate ability to respond to an owner service call via telephone and/or e-mail within two hours, regardless of time of day, day of week, holiday or other factors.

1.6 WARRANTY

A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the date of final acceptance by the Owner, as defined in other Divisions of these specifications.

B. Within this period, upon notice by the Owner, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the contractor at no expense to the Owner.

1.7 COORDINATION

A. Pre-engineering Conference

1. Prior to preparation of submittals and within 45 days of the award of the general construction contract, a pre-engineering conference will be conducted at the offices of the owner. The purpose and scope of this conference is to have the Temperature Controls Contractor present their proposed systems, architecture and communications protocols such that the basic architecture/configuration, communications and combined systems capabilities can be determined and approves

2. Attendees at this conference, at a minimum, shall be the Temperature Controls Contractor’s application engineer/programmer, the Engineer, The Owner’s representative(s) the commissioning agent, and, at the contractor’s option, any other sub-contractors or general contractor’s representatives deemed appropriate.

3. A minimum of four (4) hours shall be allocated for this conference.

B. Pre-installation Conference

1. The purpose and scope of this conference is to have the Temperature Controls Contractor present their systems, programs, graphics and basic methods of operation of the system for review and approval. This conference shall include a “walk through” of all of
the graphics screens, the logic and programming, the final system architecture, the final review of the sequence of operations and any other topics that may arise. The contractor shall make the presentation using a laptop and a projector to present the actual programs, graphics and logic that is contained on the programming computer specific to this project.

2. This Conference shall be scheduled approximately 30 days prior to starting of any HVAC equipment or installation of any programming into the building controllers on-site.

3. Attendees at this conference, at a minimum, shall be the Temperature Controls Contractor’s application engineer/programmer, the Engineer, The Owner’s representative(s) the commissioning agent, and, at the contractor’s option, any other subcontractors or general contractors representatives deemed appropriate

4. A minimum of four (4) hours shall be allocated for this conference

A. Pre Demonstration Conference

1. Prior to demonstration of the system to the Owner, the Temperature Control Contractor shall meet with the owner to discuss how the system will be started, tested and demonstrated. Prior to or during this conference, the contractor shall provide the owner with a schedule of all proposed demonstrations, training, starting, testing and commissioning activities.

1.2 OWNER SPECIFIC REQUIREMENTS

A. General

1. For digital systems, make operating and maintenance (O&M) information available at user interface locations. O&M information to include data sheets for products, system as-built diagrams, and sequences of operation.

2. Provide uninterruptable power supply and surge protector for all digital control systems to prevent power surges and short-term power outages (less than 5 min) from affecting stability of control systems

B. BACnet Network Numbering and Device Addressing for MSU HVAC Virtual Private Network:

1. All HVAC devices utilizing the MSU campus network must be connected to the HVAC VPN, unless specifically allowed to do otherwise.

2. All HVAC devices on the HVAC VPN using BACnet communication protocols must adhere to the following addressing standards for proper operation.

3. BACnet Network Number: (Range 0 – 65535):

   a. The BACnet Standard requires that all devices on the same network segment, follow the SAME network numbering structure to avoid conflicts. In the case of the HVAC VPN subnet at MSU, even though it serves multiple buildings across campus, it is currently configured as one network segment.

   b. There are three types of physical networks (IP, Ethernet, MS/TP) in the BACnet architecture. Given the current configuration of the MSU HVAC subnet, the only networks capable of utilizing unique network numbers would be MS/TP trunks, because their physical network segment falls beneath their parent Ethernet or IP device, thereby isolating them.

4. BACnet IP Network Number (all devices): 10001.

5. BACnet Ethernet Network Number (all devices): 20001.

6. BACnet MS/TP Network Numbers. Five Digit Network Number, with digits as follows:

   a. Digit 1:

      1) 3 or higher for MS/TP network type

   b. Digits 2, 3, and 4:

      1) Three-digit building number. MSU will provide this number for each building.

   c. Digit 5:

      1) Instance/trunk number. First MS/TP trunk could be 0, tenth trunk could be 9.
2) Note that if you exceed 10 MS/TP trunks, then you can start the 11th by increasing the digit 1 (mentioned above) from 3 to 4 in order to allow more MS/TP trunks.

7. BACnet Device Addressing: (Range 0 – 4194303
   a. Digit 1
      1) Range 0 to 3, starting with 1 for Bozeman campus.
   b. Digit 2, 3, and 4:
      1) Three-digit building number. Always use three digits, even if building number is less than 100. (Range 0 - 999)
   c. Digit 5
      1) Building network instance number (Range 1 to 9). If there are more than 9 subnets, then you can increase the value of digit 1 by 1 and start over.
   d. Digit 6 and 7:
      1) Device ID. This is actually an extension of Digit 5, so that the device ID is actually a three digit number 100-199, 200-299, etc.

A. Building Level Network:
   1. Protocols: LON, BACnet, and/or proprietary.
   2. Functionality:
      a. Control and coordination of all building control systems.
      b. Monitoring and changing any system parameters.
      c. Programming changes.
      d. All systems to be arranged to operate effectively in stand-alone mode when network communications are lost.
         1) Provide local outside air temperature sensor or other controls if required to provide appropriate control in stand-alone mode.
         2) Provide description of system operation in stand-alone mode. Typically, stand-alone mode should provide “occupied mode” control, and suitable operation under all conditions.

B. Operator interface at building
   1. Web browser access through campus network as indicated for external network operator interface.
   2. Graphics/text presentation similar to that for external network operator interface.
   3. Direct connection to building level controller (and/or other locations):
      a. Access via proprietary “tool”, and/or laptop computer.
      b. Provide all hardware and software required for fully functional operator interface at building level and major system controllers.
      c. Graphical/text access to entire system functionality.

C. External Network Interface
   1. Campus Network: Connect to existing campus HVAC virtual private network (VPN). Coordinate location of network connections and IP addresses with Owner.
   2. Integrate new building systems with existing vendor hardware and software serving campus whenever possible. Provide new systems or upgrade existing systems where required for new systems to be integrated into existing systems.
   3. Functionality:
      a. Monitoring any system parameter.
      b. Changing parameters where required for trouble-shooting, maintenance, or operating functions.
      c. Suitable for minimum of 10 simultaneous users with view, invoke and command/adjust capabilities.
      d. Trending set-up, access, and printing.

D. External Operator Interface
   1. General
  b. Text/tabular format option for system parameters.
  c. Graphics option with presentation similar to that for internal network operator interface.

2. Security
   a. Password hierarchy for various user access capabilities.
   b. Owner-definable limits on IP addresses which are allowed access.
   c. Embedded operating system that is not susceptible to security problems, or 10 years of software upgrades and patches to address discovered security problems.

3. Mechanical System Diagrams
   a. Summary page showing major system parameters and alarms.
   b. Provide diagrams for all major systems (air handling, heating, cooling, etc.)
   c. Graphical representation of system and components, with hyperlinks to specific information for individual components.
   d. Information for all system parameters including current value, status, set-points, and current alarms.
   e. Interactive capability for appropriate parameters (set-points, schedules, etc).

4. Building Systems and Plans
   a. Summary page showing zone temperatures and alarms.
   b. Floor plan representation of building with room numbers from construction documents.
   c. Line drawings, text, and/or colors showing general locations of equipment, and areas served by systems, zones, etc.
   d. Location of control elements outside of mechanical areas (duct pressure sensors, room sensors, etc.)
   e. Space control points (temperature, humidity, or other as provided), with current value, set-points, and current alarms.
   f. Interactive capability for appropriate parameters (set-points, schedules, etc).
   g. Hyperlinks on plans to access related system diagrams; i.e. hyperlink to proper VAV box and AHU serving a room.

5. Trending
   a. Capability to trend all significant system parameters.
   b. Trends to be set up by contractor for system parameters as requested by Owner.
   c. Contractor to set up trends so that at least 3 days, and preferably 7 days, of data are kept at all times for main system parameters.
   d. Contractor to provide a simple way to graph and print selected parameters. Graphs to be capable of having multiple parameters on one graph.
   e. Review trending capabilities and trend set-up during start-up phase and coordinate requirements with Owner.

PART 2 - PRODUCTS

2.1 CONTROL SYSTEM

A. The Museum of the Rockies is equipped with an existing DDC based building management system. It is the intent of this project that all new HVAC controls installed under this project be integrated into the existing building management system. The scope of work for this project shall include all hardware, software and programming required by the new HVAC system and any required upgrades to the existing building management system required by added controls for the new HVAC equipment.
B. The Museum's existing Building Management System consists of a Tritium Frontend with Delta controllers. As a result, Electro Controls, Missoula, MT is the only approved bidder for this project.

C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.2 NETWORK AREA CONTROLLER (NAC)

A. The contractor shall be responsible for programming the existing Network Area Controller (NAC) to accommodate the additional functions as part of this contract.

B. The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall execute application control programs to provide:
   1. Calendar functions
   2. Scheduling
   3. Trending
   4. Alarm monitoring and routing
   5. Time synchronization
   6. Integration of LonWorks controller data and BACnet controller data
   7. Network Management functions for all LonWorks based devices

C. Control equipment and network failures shall be treated as alarms and annunciated.

D. Alarms shall be annunciated in any of the following manners as defined by the user:
   1. Screen message text
   2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
      a. Day of week
      b. Time of day
      c. Recipient
   3. Pagers via paging services that initiate a page on receipt of email message
   4. Graphic with flashing alarm object(s)
   5. Printed message, routed directly to a dedicated alarm printer
   6. Dial up to a secondary security office.

E. The following shall be recorded by the NAC for each alarm (at a minimum):
   1. Time and date
   2. Location (building, floor, zone, office number, etc.)
   3. Equipment (air handler #, accessway, etc.)
   4. Acknowledge time, date, and user who issued acknowledgement.
   5. Number of occurrences since last acknowledgement.

F. Alarm actions may be initiated by user defined programmable objects created for that purpose.

G. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
H. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.

I. Provide a "query" feature to allow review of specific alarms by user defined parameters.

J. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

K. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

2.3 DATA COLLECTION AND STORAGE

A. The NAC shall collect data for any property of any object and store this data for future use.

B. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:
   1. Designating the log as interval or deviation.
   2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
   3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
   4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
   5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

C. All log data shall be stored in a relational database in the NAC.

D. Note that the contractor will configure the system, tailored to the Owner’s request, to archive logs to the server automatically based upon one or more of the four criteria above. This will be determined at the preinstallation conference.

2.4 GRAPHICAL USER INTERFACE SOFTWARE

A. Operating System: To run on latest Windows or Apple operating system

B. Provide programming as necessary to create the additional graphics.

C. Graphics shall provide “quick links” or “jump tags” from an operating graphic directly to a trend, by left clicking on the numerical value to be trended.

2.5 Graphical Pages

A. The system shall be expanded and organized so as to provide a logical, functional grouping of data on each graphical page(s) with pertinent information and functional devices for each system. Each page shall have “buttons” which will be for linking or navigating to all the other screens created for this system. This includes links to the scheduling and alarm functions in the system. On all pages, each button will display a red flashing condition if an alarm exists on its respective system depicted on that screen.

B. Graphics shall include:
   1. Graphics shall be dynamic, indicating status of fans, pumps, dampers and valves.
2. All outputs shall be overridable.
3. All overridden points shall be indicated as such on the graphic.
4. All setpoints shall be adjustable on the respective graphics page. Include an option to return to a default setpoint.
5. All logs of inputs and outputs shall be accessed by clicking on the point.

C. At a minimum, the graphical pages shall be arranged as follows. The final layout and grouping of the pages and points shall be determined at the pre engineering conference, and this shall be used as a basic guideline for graphical page creation.

1. Main Page – The existing main page shall include "link buttons" to all other pages added to the system. These buttons may be arranged along the top, bottom, or side of the page, and also may be arranged as a menu "tree" along the side of the page. The "menu tree" will provide access to other pages such as alarm pages, scheduling functions, log/trend functions, etc.
2. Provide an overall graphics page showing the new controls with links to individual pages. Show clearly if the north or south zone is in a heating or cooling mode. All temperature points shall be shown on the graphics.
3. At a minimum, the following graphics shall be included:
   a. Heat pump water loop including associated pumps.
   b. Individual VRF systems – each VRF system shall include the heat pump and all associated fancoils.
   c. Heat and Energy Recovery Units

2.6 DDC EQUIPMENT

A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   a. Global communications.
   b. Discrete/digital, analog, and pulse I/O.
   c. Monitoring, controlling, or addressing data points.
   d. Software applications, scheduling, and alarm processing.
   e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

B. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   a. Global communications.
   b. Discrete/digital, analog, and pulse I/O.
   c. Monitoring, controlling, or addressing data points.
3. Local operator interface provides for download from or upload to operator workstation.

C. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
7. Universal I/Os: Provide software selectable binary or analog outputs.

D. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

E. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
1. Minimum dielectric strength of 1000 V.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.7 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
3. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).

2.8 ANALOG CONTROLLERS

A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F (minus 23 to plus 21 deg C), and single- or double-pole contacts.
C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
E. Retain subparagraph below if applicable.
   1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
F. Verify that fan-speed controller is compatible with fan motor.

D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

2.9 TIME CLOCKS

A. Manufacturers:
   1. ATC-Diversified Electronics.
   2. Grasslin Controls Corporation.
   3. Paragon Electric Co., Inc.
   4. Precision Multiple Controls, Inc.
   5. SSAC Inc.; ABB USA.
   6. TCS/Basys Controls.
   7. Theben AG - Lumilite Control Technology, Inc.
   8. Time Mark Corporation.

B. Solid-state, programmable time control with 8 separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

C. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

D. Thermistor Temperature Sensors and Transmitters:
   G. Coordinate first subparagraph and list below with Part 2 "Manufacturers" Article. Retain "Available" for nonproprietary and delete for semiproprietary specifications. If list does not include manufacturers of systems that make or market this equipment under their own name, those manufacturers' names may be added. List can be deleted if it is not important that specific manufacturers be named for this product.
   1. Accuracy: Plus or minus 0.36 deg F at calibration point.
   2. Wire: Twisted, shielded-pair cable.
   3. Insertion Elements in Ducts: Single point, 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
   4. Averaging Elements in Ducts: 72 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
   5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.

E. Pressure Transmitters/Transducers:
1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
   a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
   b. Output: 4 to 20 mA.
   c. Building Static-Pressure Range: 0- to 0.25-inch wg.
   d. Duct Static-Pressure Range: 0- to 5-inch wg.
2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
5. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.

F. Room Sensors
1. Room sensors in public spaces shall be blank face sensors with no use adjustment.

2.10 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.11 GAS DETECTION EQUIPMENT

A. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting.
2.1 REFRIGERANT LEAK DETECTORS

A. Manufacturers:
   1. SenTech Corp.
   2. Approved equal

B. Multizone leak detection system.

C. Sensitivity: 1 PPM

D. Range: 0-1000 PPM

E. Operating temperature: 0F-125F

F. Alarm Outputs: Indicator light, 3 alarm relays, 1 horn relay

G. Alarm Trip Points:
   1. Low Alarm: 0-100% of full scale
   2. Main Alarm: 0-100% of full scale
   3. High Alarm: 0-100% of full scale

H. Power Requirements: 120/240V

2.2 THERMOSTATS

A. Manufacturers:
   1. Same as all other equipment.

B. Electric, solid-state, microcomputer-based room thermostat.
   1. All thermostats shall be simplified units and only include user setpoint adjustment and occupancy override button.

C. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
   1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.

D. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
   1. Bulbs in water lines with separate wells of same material as bulb.
   2. Bulbs in air ducts with flanges and shields.
   3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
   4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
   5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
6. **Modulating Thermostats**: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

**H. Coordinate first paragraph below with latest edition of NFPA 90A.**

**E. Immersion Thermostat**: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

**F. Airstream Thermostats**: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

**G. Electric, Low-Limit Duct Thermostat**: Snap-acting, single-pole, single-throw, manual (freezestat use) or automatic-reset switch that trips if temperature sensed across any **12 inches** of bulb length is equal to or below set point.
   1. **Bulb Length**: Minimum **20 feet**.
   2. **Quantity**: One thermostat for every **20 sq. ft.** of coil surface.

**H. Electric, High-Limit Duct Thermostat**: Snap-acting, single-pole, single-throw, automatic-reset switch that trips if temperature sensed across any **12 inches** of bulb length is equal to or above set point.
   1. **Bulb Length**: Minimum **20 feet**.
   2. **Quantity**: One thermostat for every **20 sq. ft.** of coil surface.

**I. Heating/Cooling Valve-Top Thermostats**: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of **25 psig**, and cast housing with position indicator and adjusting knob.

**J. Outside air temperature sensor**: Locate on the north side of the building, not exposed to direct sunlight. Run wiring necessary to run from outside air thermostat back to main panel.

### 2.3 HUMIDISTATS

**A. Manufacturers**:
   1. Same as all other equipment

**B. Duct-Mounting Humidistats**: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

### 2.4 ACTUATORS

**A. Electronic Actuators**: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
   1. Coordinate first subparagraph and list below with Part 2 "Manufacturers" Article. Retain "Available" for nonproprietary and delete for semiproprietary specifications. If list does not include manufacturers of systems that make or market this equipment under their own name, those manufacturers' names may be added. List can be deleted if it is not important that specific manufacturers be named for this product.

**B. Manufacturers**:
   1. Same as all other equipment

**C. Valves**: Size for torque required for valve close off at maximum pump differential pressure.
D. Dampers: Size for running torque calculated as follows:
1. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
2. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
4. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
5. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
6. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

E. Coupling: V-bolt and V-shaped, toothed cradle.

F. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

G. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.

H. Power Requirements (Two-Position Spring Return): 24-V ac.

I. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.

J. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.

K. Temperature Rating: Minus 22 to plus 122 deg F.

L. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.

M. Run Time: 12 seconds open, 5 seconds closed.

2.5 DAMPERS

A. Manufacturers:
1. Same as all other equipment.

B. Dampers: AMCA-rated, opposed-blade design; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.6 CONTROL CABLE

A. Plenum rated.
2.7 VARIABLE FREQUENCY DRIVES

A. Manufacturer:
   1. Danfoss
   2. ABB
   3. Prior Approved Equal

B. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

C. Unit Operating Requirements:
   1. Input ac voltage tolerance of plus or minus 10 percent.
   2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
   3. Minimum Efficiency: 96 percent at 60 Hz, full load.
   5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
   6. Starting Torque: 100 percent of rated torque or as indicated.
   7. Speed Regulation: Plus or minus 1 percent.

D. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

E. Internal Adjustability Capabilities:
   1. Minimum Speed: 5 to 25 percent of maximum rpm.
   2. Maximum Speed: 80 to 100 percent of maximum rpm.
   3. Acceleration: 2 to a minimum of 22 seconds.
   4. Deceleration: 2 to a minimum of 22 seconds.
   5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

F. Self-Protection and Reliability Features:
   a. Input transient protection by means of surge suppressors.
   b. Undervoltage and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
   c. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
   d. Instantaneous line-to-line and line-to-ground overcurrent trips.
   e. Loss-of-phase protection.
   f. Reverse-phase protection.
   g. Short-circuit protection.
   h. Motor overtemperature fault.

G. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

H. Power- Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.

I. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
J. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

K. Door-mounted LED status lights shall indicate the following conditions:
   a. Power on.
   b. Run.
   c. Overvoltage.
   d. Line fault.
   e. Overcurrent.
   f. External fault.


M. Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
   a. Output frequency (Hertz).
   b. Motor speed (rpm).
   c. Motor status (running, stop, fault).
   d. Motor current (amperes).
   e. Motor torque (percent).
   f. Fault or alarming status (code).
   g. Proportional-integral-derivative (PID) feedback signal (percent).
   h. DC-link voltage (volts direct current).
   i. Set-point frequency (Hertz).
   j. Motor output voltage (volts).

N. Control Signal Interface:
   1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
   2. Remote signal inputs capable of accepting any of the following speed-setting input signals from the control system:
      1) 0 to 10-V dc.
      2) 0-20 or 4-20 mA.
      3) Fixed frequencies using digital inputs.
      4) RS485.
      5) Keypad display for local hand operation.
   3. Output signal interface with a minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
      1) Output frequency (Hertz).
      2) Output current (load).
      3) DC-link voltage (volts direct current).
      4) Motor torque (percent).
      5) Motor speed (rpm).
      6) Set-point frequency (Hertz).
   4. Remote indication interface with a minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
      1) Motor running.
2) Set-point speed reached.
3) Fault and warning indication (over temperature or overcurrent).
4) High- or low-speed limits reached.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 60 inches (1530 mm) above the floor.
   1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

B. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

C. Install labels and nameplates to identify control components according to Section "Identification for HVAC Piping and Equipment."

D. Install hydronic instrument wells, valves, and other accessories according to Section "Hydronic Piping."

E. Install refrigerant instrument wells, valves, and other accessories according to Section "Refrigerant Piping."

F. Install duct volume-control dampers according to Section "Metal Ducts" and Section "Nonmetal Ducts."

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Section "Raceways and Boxes for Electrical Systems."

B. Install building wire and cable according to Section "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Section "Communications Horizontal Cabling."
   1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
   2. Install exposed cable in raceway.
   3. Install concealed cable in raceway.
   4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
   5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
   6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
   7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
   2. Test and adjust controls and safeties.
   3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
   4. Test each point through its full operating range to verify that safety and operating control set points are as required.
   5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
   6. Test each system for compliance with sequence of operation.
   7. Test software and hardware interlocks.

C. DDC Verification:
   1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
   2. Check instruments for proper location and accessibility.
   3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
   4. Check instrument tubing for proper fittings, slope, material, and support.
   5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
   6. Check temperature instruments and material and length of sensing elements.
   7. Check control valves. Verify that they are in correct direction.
   8. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
   9. Check DDC system as follows:
      a. Verify that DDC controller power supply is from emergency power supply, if applicable.
      b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
      c. Verify that spare I/O capacity has been provided.
      d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.4 DEMONSTRATION & TRAINING

A. See specification Section 01 9113 for training requirements.

END OF SECTION 23 0900
SECTION 23 0993

SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. See Section 23 0900 Instrumentation and Control for HVAC for control equipment and devices and for submittal requirements.

B. See drawings for control diagrams, DDC points lists and sequence of operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 0993
SECTION 23 2113
HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hydronic Piping and Fittings
2. Dielectric Fittings
3. Air Control Devices
4. Propylene Glycol
5. Hydronic Specialties

B. See Section 23 2123 "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.2 ACTION SUBMITTALS

A. Product Data:
1. Propylene Glycol
2. Hydronic Specialties

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 150 psig at 200 deg F.
2. Heat Pump Piping: 150 psig at 200 deg F.
3. Condensate-Drain Piping: 150 deg F.
4. Air-Vent Piping: 200 deg F.
5. Safety-Valve-Inlet and -Outlet Piping: 150 psig at 200 deg F.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).
2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.


E. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   2. End Connections: Butt welding.
   3. Facings: Raised face.

F. Grooved Mechanical-Joint Fittings and Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. Central Sprinkler Company; a division of Tyco Fire & Building Products.
      c. National Fittings, Inc.
      d. S. P. Fittings; a division of Star Pipe Products.
      e. Victaulic Company.
   2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
   3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
B. 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 joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

D. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Dielectric Unions are not allowed.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
   b. Central Plastics Company.
   c. Matco-Norca.
   d. Watts; a division of Watts Water Technologies, Inc.
   e. Wilkins; a Zurn company.

3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 175 psig (1200 kPa).
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

2. Nonconducting materials for field assembly of companion flanges.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Elster Perfection Corporation.
b. Grinnell Mechanical Products; Tyco Fire Products LP.
c. Matco-Norca.
d. Precision Plumbing Products, Inc.
e. Victaulic Company.

3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C).
5. End Connections: Male threaded or grooved.

2.6 AIR CONTROL DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hoffman
   2. Armstrong Pumps, Inc.
   3. Taco.

B. Manual Air Vents:
   1. Body: Bronze.
   2. Internal Parts: Nonferrous.
   3. Operator: Screwdriver or thumbscrew.
   4. Inlet Connection: NPS 1/2 (DN 15).
   5. Discharge Connection: NPS 1/8 (DN 6).
   6. CWP Rating: 150 psig (1035 kPa).

2.7 PROPYLENE GLYCOL

A. Propylene Glycol: To match product used to fill the existing system. Coordinate with owner prior to filling.

2.8 HYDRONIC PIPING SPECIALTIES

A. Iron Body Manual Flow Control Valves
   1. Manufacturers:
      a. Taco
      b. FDI
      c. Nexus
   2. Description: Globe type calibrated, manual flow control valve with flanged connections and two (2) P/T ports.
   3. Size: 2-1/2” to 6”
   4. Body: Cast Iron, ASTM A126, Class B, 175 PSIG, 250F
   5. Trim: Brass & Stainless Steel
   6. Seal: EPDM
   7. Globe: Ryton
   8. Accuracy: +/- 5%
B. Bronze Body Manual Flow Control Valves
   1. Manufacturers:
      a. Taco
      b. Nexus
      c. FDI
   2. Description: Ball type, calibrated, manual flow control valves with sweat or threaded connections and two (2) P/T ports.
   3. Size: \( \frac{1}{2}'' \) to 2-1/2''
   4. Body: Hot Forged Brass, ASTM B283, 600 WOG, 325F
   5. Trim: Stainless Steel
   6. Accuracy: +/- 3%

C. Iron Body Automatic Flow Control Valves
   1. Manufacturers:
      a. Nexus
      b. FDI
   2. Description: Wafer style automatic flow control valve with two T/P ports.
   3. Size 2-1/2'' to 6''
   4. Body: Epoxy Coated Ductile Iron, ASTM A536, 400 PSIG, 350F.
   5. Trim: Brass and Stainless Steel
   6. Accuracy: +/- 5%

D. Bronze Body Automatic Flow Control Valves
   1. Manufacturers:
      a. Nexus
      b. FDI
   2. Description: Combination ball valve and automatic flow control valve.
   3. Size: \( \frac{1}{2}'' \) to 2-1/2''
   4. Body: Hot Forged Brass, ASTM B283, 600 WOG, 325F
   5. Trim: Stainless Steel
   6. Accuracy: +/- 5%

E. Iron Body Y-Pattern Strainers:
   1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
   3. Strainer Screen: Stainless Steel AISI 304, perforated

F. Bronze Y-Pattern Strainers:
   1. Body:
      a. Bronze ASTM B584 Alloy C84400 (solder ends)
      b. Bronze ASTM B62 Alloy C83600 (threaded ends)
3. Gasket: PTFE
4. Screen: ASTM E674 Perforated – 304 Stainless Steel

G. Expansion fittings are specified in Section 23 0516 "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Heat Pump piping, aboveground, NPS 1/2 and larger, shall be:
   1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

B. Condensate-Drain Piping: Type M (C), drawn-temper copper tubing, wrought-copper fittings, and soldered joints OR press-seal joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

C. Air-Vent Piping:
   1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
   2. Outlet: Type K (A), annealed-temper copper tubing with soldered or flared joints.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install balancing valves in the return pipe of each heating or cooling terminal. See coil piping details for balance valve type.

C. Install check valves at each pump discharge and elsewhere as required to control flow direction.

D. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Pipe discharge piping without valves to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
E. Install piping to permit valve servicing.
F. Install piping at indicated slopes.
G. Install piping free of sags and bends.
H. Install fittings for changes in direction and branch connections.
I. Install piping to allow application of insulation.
J. Select system components with pressure rating equal to or greater than system operating pressure.
K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
L. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
P. Install valves according to Section 23 0523 "General-Duty Valves for HVAC Piping."
Q. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
R. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.
S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).
T. Identify piping as specified in Section 23 0553 "Identification for HVAC Piping and Equipment."
U. Install sleeves for piping penetrations of walls, ceilings, and floors.
V. Install sleeve seals for piping penetrations of concrete walls and slabs.
W. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Section 23 0529 "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
B. Seismic restraints are specified in Section 23 0548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
   2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
   4. Spring hangers to support vertical runs.
   5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
   6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
   2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
   3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
   4. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
   5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (10 mm).
   6. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (10 mm).
   7. NPS 4 (DN 100): Maximum span, 12 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
   2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
   3. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
   4. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
   5. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
   6. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).

F. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

H. INSPECTING AND CLEANING

1. The pipes should be flushed with cold water after finishing the installation. Inspect and test piping systems following procedures of authorities having jurisdiction and as specified by the piping system manufacturer.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.

D. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches (1200 mm) above the floor. Install feeder in minimum NPS 3/4 (DN 20) bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 (DN 20) pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.
C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 23 0519 "Meters and Gages for HVAC Piping."

3.8 CHEMICAL TREATMENT

A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

B. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

C. Fill systems indicated to have antifreeze or glycol solutions with the following concentrations:

3.9 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
   3. Isolate expansion tanks and determine that hydronic system is full of water.
   4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
   5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
   6. Prepare written report of testing.

C. Perform the following before operating the system:
   1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 23 2113
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wet Rotor, variable speed, in-line circulator.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Pumps

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 Wet Rotor, variable speed, in-line circulator

A. Manufacturers: Subject to compliance with requirements, provide product the following:

1. Grundfos Magna III Series
2. Taco Varidian

B. Features:

1. Quiet operation
2. Direct drive
3. Replaceable cartridge
4. Self Lubricating
5. No mechanical seal
6. Where specified provide pump with ECM motor and integral controls that allow:

   a. Variable speed operation to achieve constant pressure control, variable pressure control, proportional pressure control, constant curve duty, RPM regulation, and power limitation control.
   b. Pump control shall include two (2) external digital inputs and one (1) external digital output and web interface for setup, commissioning and maintenance through a RJ-45 cable connection.

C. Materials

1. Casing: Cast Iron
2. Stator housing: Aluminum
3. Cartridge: Stainless Steel
4. Impeller: Non-Metalic or metallic
5. Shaft: Ceramic
6. Bearings: Carbon
7. O-Rings, Gaskets: EPDM
PART 3 - EXECUTION

3.1 PUMP INSTALLATION

A. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

B. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

C. Equipment Mounting:
   1. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 0548 "Vibration and Seismic Controls for HVAC."

D. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers of size required to support weight of in-line pumps.
   1. Comply with requirements for seismic-restraint devices specified in Section 23 0548 "Vibration and Seismic Controls for HVAC."
   2. Comply with requirements for hangers and supports specified in Section 23 0529 "Hangers and Supports for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Where installing piping adjacent to pump, allow space for service and maintenance.

B. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

D. Install check, shutoff, and throttling valves or triple-duty valve on discharge side of pumps.

E. Install Y-type strainer or suction diffuser and shutoff valve on suction side of pumps.

F. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.

G. Install check valve and gate or ball valve on each condensate pump unit discharge.

H. Ground equipment according to Section 26 0526 "Grounding and Bonding for Electrical Systems."

I. Connect wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 MANUFACTURER’S FIELD SERVICES

A. General: The supplier’s factory authorized service organization shall be responsible for performance of inspections, start up and testing of pumps specified in this section, and accessory equipment and materials furnished under this Section. A detailed written record of the start up performance shall be furnished to the engineer before final acceptance. All labor, equipment, and test apparatus shall be furnished by the authorized service organization. All equipment defects discovered by the tests shall be rectified either by the service organization or the manufacturer.
B. Start-up shall be conducted by experienced and factory authorized technician in the regular employment of the authorized service organization, and shall include:

1. Demonstrate that controls, and accessories comply with requirements of this Section, Pre-test all items prior to scheduling the final testing that will be witnessed by the engineer.
2. Output readings at different capacities (20, 50, 75 and 100%) of load shall be taken and a written report of the tests shall be submitted to the engineer.
3. Auxiliary Equipment and Accessories: Observe and check all accessories and appurtenant equipment during the operational and capacity tests for leakage, malfunctioning, defects, and non-compliance with referenced standards or overloading as applicable.

END OF SECTION 23 2123
SECTION 23 3113  
METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Rectangular ducts and fittings.
   2. Round ducts and fittings.
   4. Sealants and gaskets.
   5. Hangers and supports.

B. Related Sections:
   1. Section 23 0593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.3 ACTION SUBMITTALS

A. Product Data: None Required

1.4 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-
D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger Than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: [G60 (Z180)] [G90 (Z275)].
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Solids Content: Minimum 65 percent.
   5. Mold and mildew resistant.
   6. VOC: Maximum 75 g/L (less water).
   7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
   8. Service: Indoor or outdoor.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.
   2. Type: S.
   3. Grade: NS.
   5. Use: O.
   6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
   2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
   3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.6 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper B-Line, Inc.; a division of Cooper Industries.
   2. Ductmate Industries, Inc.
   3. Hilti Corp.
   5. Unistrut Corporation; Tyco International, Ltd.

B. 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.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections OR Reinforcing steel angle clamped to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 3300 "Air Duct Accessories" for fire and smoke dampers.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.
C. Hanger Spacing: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) 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 (5 m).

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
2. Brace a change of direction longer than 12 feet (3.7 m).

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer’s recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.
3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 23 3300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 DUCT CLEANING

A. Clean existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 3300 "Air Duct Accessories" for access panels and doors.

2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.

3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.

2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.

3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.


5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.


7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.

3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.

5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

6. Provide drainage and cleanup for wash-down procedures.

7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer’s written instructions after removal of surface deposits and debris.

3.8 START UP

A. Air Balance: Comply with requirements in Section 23 0593 "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Constant-Volume Air-Handling Units:
   a. Pressure Class: Positive 2-inch wg (500 Pa).
   b. Minimum SMACNA Seal Class: B.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Equipment Not Listed Above:
   a. Pressure Class: Positive 2-inch wg (1000 Pa).
   b. Minimum SMACNA Seal Class: B.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

C. Return Ducts:

1. Ducts Connected to Air-Handling Units:
   a. Pressure Class: Positive or negative 2-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: C.
   c. SMACNA Leakage Class for Rectangular: 24.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Equipment Not Listed Above:
   a. Pressure Class: Positive or negative 2-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: C.
   c. SMACNA Leakage Class for Rectangular: 24.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
a. Pressure Class: Negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Equipment Not Listed Above:
   a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
   b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
   1. Ducts Connected to Air-Handling Units:
      a. Pressure Class: Positive or negative 2-inch wg (750 Pa).
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 6.
   2. Ducts Connected to Equipment Not Listed Above:
      a. Pressure Class: Positive or negative 2-inch wg (750 Pa).
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 6.

F. Intermediate Reinforcement:
   1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
   2. Stainless-Steel Ducts:
      a. Exposed to Airstream: Match duct material.
      b. Not Exposed to Airstream: Match duct material.
   3. Aluminum Ducts: Aluminum.

G. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
      a. Velocity 1000 fpm (5 m/s) or Lower:
         1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
         2) Mitered Type RE 4 without vanes.
      b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
         1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
         2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm (7.6 m/s) or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to-Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.

c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.

b. Rectangular Main to Round Branch: Spin in.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.

b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
c. Velocity **1500 fpm (7.6 m/s)** or Higher: 45-degree lateral.

END OF SECTION 23 3113
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Backdraft dampers.
   3. Control dampers.
   4. Flange connectors.
   5. Turning vanes.
   6. Duct-mounted access doors.
   7. Flexible connectors.
   8. Flexible ducts.
   9. Duct accessory hardware.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. None Required

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION


B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 3 finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 BACKDRAFT DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cesco Products; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Ruskin Company.

B. Description: gravity and counterbalanced as indicated on the plans.

C. Maximum Air Velocity: 1000 fpm (5.1 m/s).

D. Maximum System Pressure: 2-inch wg (0.5 kPa).

E. Frame: Hat-shaped, 0.094-inch-(2.4-mm-) thick, galvanized sheet steel or 0.090-inch-(2.4-mm-) thick extruded aluminum, with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, maximum 4-inch (150-mm) width, 0.025-inch-(0.6-mm-) thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked.

I. Blade Axles:

1. Material: Galvanized steel.
2. Diameter: 0.20 inch (5 mm).

J. Counterbalance: Zinc plated steel weights, adjustable.

K. Bearings: synthetic pivot bushings.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cesco Products; a division of Mestek, Inc.
   b. Greenheck Fan Corporation.
   c. Nailor Industries Inc.
   d. Ruskin Company.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.

4. Frames:
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:
   a. Multiple or single blade.

6. Bearings:
   a. Molded synthetic.
   b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

7. Tie Bars and Brackets: Galvanized steel.

2.5 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cesco Products; a division of Mestek, Inc.
   2. Greenheck Fan Corporation.
   3. Nailor Industries Inc.
   4. Ruskin Company.

B. Frames:
   1. U shaped.
   2. 0.081-inch- (2.4-mm-) thick, galvanized sheet steel.
   3. Mitered and welded corners.

C. Blades:
   1. Multiple blade with maximum blade width of 4 inches (100 mm).
   2. Parallel-blade design.
   3. Aluminum.
   4. 0.0747-inch- (1.9-mm-) thick dual skin.

D. Blade Axles: 1/2-inch- (13-mm-) diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
   1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

E. Bearings:
   1. Molded synthetic.
2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.6 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Ductmate Industries, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.7 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. METALAIRE, Inc.
5. SEMCO Incorporated.

B. 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.


C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanatcs and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Single wall.

2.8 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cesco Products; a division of Mestek, Inc.
2. Ductmate Industries, Inc.
4. McGill AirFlow LLC.
5. Nailor Industries Inc.

1. Door:
   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
   b. Access Doors up to [18 Inches (460 mm)] Square: Two hinges and two sash locks.
   c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Continuous and two compression latches.
   d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Continuous and two compression latches with outside and inside handles.

2.9 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Flame Gard, Inc.
   3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch (1.3-mm) carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).

F. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

2.10 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Inc.
   3. Elgen Manufacturing.
   4. Ventfabrics, Inc.
5. **Ward Industries, Inc.; a division of Hart & Cooley, Inc.**

B. **Materials**: Flame-retardant or noncombustible fabrics.

C. **Coatings and Adhesives**: Comply with UL 181, Class 1.

D. **Metal-Edged Connectors**: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch (70-mm) wide, 0.028-inch (0.7-mm) thick, galvanized sheet steel or 0.032-inch (0.8-mm) thick aluminum sheets. Provide metal compatible with connected ducts.

E. **Indoor System, Flexible Connector Fabric**: Glass fabric double coated with neoprene.
   1. **Minimum Weight**: 26 oz./sq. yd. (880 g/sq. m).
   2. **Tensile Strength**: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
   3. **Service Temperature**: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

F. **Outdoor System, Flexible Connector Fabric**: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
   1. **Minimum Weight**: 24 oz./sq. yd. (810 g/sq. m).
   2. **Tensile Strength**: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
   3. **Service Temperature**: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

### 2.11 FLEXIBLE DUCTS

A. **Manufacturers**: Subject to compliance with requirements, provide products by one of the following:
   1. Flexmaster U.S.A., Inc.
   2. McGill AirFlow LLC.
   4. Thermaflex

B. **Insulated, Flexible Duct**: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
   1. **Pressure Rating**: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
   2. **Maximum Air Velocity**: 4000 fpm (20 m/s).
   3. **Temperature Range**: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
   4. **Insulation R-value**: Comply with ASHRAE/IESNA 90.1.

C. **Flexible Duct Connectors**:
   1. **Clamps**: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

### 2.12 DUCT ACCESSORY HARDWARE

A. **Instrument Test Holes**: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, “Fibrous Glass Duct Construction Standards,” for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

   1. On both sides of duct coils.
   2. Upstream and downstream from duct filters.
   3. At outdoor-air intakes and mixed-air plenums.
   4. At drain pans and seals.
   5. Downstream from backdraft dampers, and equipment.
   6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links.
   7. At each change in direction and at maximum 50-foot (15-m) spacing.
   8. Upstream or downstream from duct silencers.
   9. Control devices requiring inspection.
  10. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

   1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
   2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
   3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
   4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).

K. Label access doors according to Section 23 0553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. Connect terminal units to supply ducts directly.

N. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

O. Connect flexible ducts to metal ducts with draw bands.

P. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 3300
SECTION 23 3713
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Diffusers.
2. Registers.
4. Louvers.
5. Dampers.

B. Related Sections:

1. Division 15 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with requirements, provide products by one of the following:

1. Grilles, Registers, & Diffusers: Grilles, Registers, & Diffusers:
   a. Krueger.
   b. Nailor

2. Louvers:
   a. Ruskin
   b. Nailor
   c. Cesco

3. Dampers
   a. Ruskin
   b. Nailor

B. Capacity and Performance:

1. As scheduled on the drawings.
2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 3713
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed-plate total heat exchangers.

1.2 ACTION SUBMITTALSMERV24

A. Product Data: For each type of product indicated.

B. Shop Drawings: For air-to-air energy recovery equipment. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Provide factory trained and certified personnel to the jobsite for startup and training for a period of up to 8 hours.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ARI Compliance:


C. ASHRAE Compliance:

1. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

2. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."
1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air-to-air energy recovery equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Fixed-Plate Total Heat Exchangers: 10 years.

2. In the event of problems with the unit during the first one year of operation, provide a factory trained and certified technician to troubleshoot the equipment on-site.

PART 2 - PRODUCTS

2.1 FIXED-PLATE TOTAL HEAT EXCHANGERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Renewaire

2. Prior Approved Equal

B. General:

1. Unit shall be a packaged unit and shall transfer both heat and humidity using static plate core technology. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.

2. The unit shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.

C. Cabinet:

1. The unit case shall be constructed of G90 galvanized, 20-gauge steel, with lapped corners and zinc plated screw fasteners. Provide double wall construction with 24-gauge galvanized steel liner.

2. Access doors shall provide easy access to blowers, ERV cores, and filters. Doors shall have an airtight compression seal using closed cell foam gaskets. Pressure taps, with captive plugs, shall be provided allowing cross-core pressure measurement allowing for accurate airflow measurement.

3. Case walls and doors shall be insulated with 1 inch, 4 pound density, foil/scrim faced, high-density fiberglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibers, and with minimum R-value of 4.3 (hr·ft²·°F/BTU). EV450IN case walls and doors shall be insulated with 7/8 inch, expanded polystyrene foam insulation faced with a cleanable foil face on all exposed surfaces.

D. Energy Recovery Core: The energy recovery core shall be of fixed-plate cross-flow construction, with no moving parts.
E. Filters: The ERV cores shall be protected by a MERV-8 rated, 2” nominal, pleated, disposable filter in both airstreams.

F. Fan Motors: Fan motors shall be Premium Efficiency, EISA compliant for energy efficiency. The blower motors shall be totally enclosed (TEFC) and be shall be supplied with factory installed motor starters.

G. Fans: Fans shall be quiet running, forward curve type with belt drive. Belt drive motors shall be provided with adjustable pulleys and motor mounts allowing for blower speed adjustment, proper motor shaft orientation and proper belt tensioning.

H. Dampers: Provide factory installed isolation dampers for both air streams. The insulated dampers shall be of a low leakage design and shall not restrict the airstream, reducing airflow, in any way. The dampers shall be opened with a motor actuator powered by the standard unit transformer package and have a spring return for low off-position power consumption.

I. Provide factory installed Variable Frequency Drives allowing either preset or variable speed operation with appropriate 0-10 volt DC or DDC control signal.

J. Controls: See Sections 230900 and 230933 and the drawings for additional information.

K. Electrical: Unit shall have single-point power connection and a single-point 24 VAC contactor control connection. The unit electrical box shall include a factory installed, non-fused disconnect switch and a 24 VAC, Class II transformer/relay package.

2.2 CAPACITIES AND CHARACTERISTICS

A. Exhaust Air:
   1. See Drawings.

B. Supply Air:
   1. See Drawings.

C. Effectiveness:
   1. See Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install unit in accordance with the manufacturers written instructions.

B. Unit Location:
   1. Locate and orient unit to provide the shortest and most straight duct connections. Provide service clearances as indicated on the plans. Locate units distant from sound critical occupancies.

   2. Provide a poured concrete equipment pad for all floor mounted units. The pad thickness and floor plan dimensions to be determined based on the unit selected, and site structural considerations. At a minimum the pad shall be the same size as the units footprint. Field coordinate the size of the pad in the field with the architect and engineer.
3. Provide a structurally suitable support for the base of any wall mounted or hung units.

C. Vibration Isolation:
   1. Provide rubber or spring type isolators appropriately sized for corner weights of the specific unit.
   2. Provide flexible duct connections at unit duct flanges.

D. Duct Work:
   1. All ductwork shall be constructed, supported and sealed in accordance with SMACNA HVAC Duct Construction Standards and pressure classifications.

E. Sound Control:
   1. To control sound radiated from the unit: Provide acoustic treatment in mechanical room walls and ceilings.
   2. To control sound associated with the two blower outlets:
      3. Provide straight, gradual transition ductwork for a minimum of 2-1/2 duct diameters downstream from the blower outlet for air velocities of less than 2,500 feet per minute.
      4. Provide continuous acoustic insulation treatment of the duct until after the first elbow or tee.

F. Testing and Balancing:
   1. Inspect installation
   2. Verify motor rotation.
   3. Verify operation of dampers and damper actuators.
   4. Verify sequence of operations.
   5. See section 23 0593 "Testing Adjusting and Balancing"

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   2. After installing units and after electrical circuitry has been energized, test for compliance with requirements.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
B. Prepare test and inspection reports.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

3.4 End of Section
SECTION 23 8123
PRECISION HVAC UNITS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:
   1. Vertical, Self-Contained, Water Cooled Precision HVAC Units

1.02 ACTION SUBMITTALS

A. Product Data:
   1. Vertical, Self-Contained, Water Cooled Precision HVAC Units

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, using input from installers of the items involved.
B. Field quality-control reports.
C. Sample warranty.

1.04 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.05 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   2. Warranty Period for Control Boards: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Stulz ATS
B. Liebert
C. Prior approved equal.

2.02 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

2.03 COMPUTER ROOM AIR CONDITIONING UNITS

A. Description: Floor Mounted air conditioner designed and built to provide precision temperature and humidity control. The system shall be complete and factory run-tested before shipment.

B. Cabinet: Heavy gauge galvanized steel with powder coated paint. The panels shall be lined with 1/2" (13 mm), 2 lb (.90 kg), high-density sound and thermal insulation and sealed with self-extinguishing gasketing conforming to NFPA 90A and 90B.

C. Electrical:

1. The system shall incorporate modular motor controllers utilizing motor start protectors and circuit breakers eliminating the need for fusing, as well as providing:
   a. Motor branch circuit short circuit protection
   b. Motor load switching controllers (contactors)
   c. Motor overload protection

2. The system shall incorporate overcurrent and overload protection in accordance with UL requirements.
3. Each blower motor, compressor, electric heater stage and humidifier shall be provided with a factory mounted and wired starter/contactor.
4. The control circuit shall be a 24 VAC Class 2 low voltage circuit including a circuit breaker for protection.
5. Low voltage, high voltage and grounding wires shall be color coded and shall be individually numbered at each end for ease of service tracing. All wiring shall be in accordance with the National Electric Code (NEC).
6. A unit-mounted main power service switch shall be provided. The service switch shall be a dust-proof, non-fused type with lockable handle
7. Included in the system’s electrical control circuit shall be a 2 –pin terminal connection for remote stop/start of the unit by remote source.

D. Evaporator Coils:

1. Evaporator systems shall be configured for a draw-thru air pattern to provide uniform air distribution over the evaporator coil face.
2. The coils shall be seamless drawn copper tubes, mechanically bonded to tempered aluminum fins with fin pattern designed for maximum heat transfer. Coil end plates shall be hot dipped galvanized.
3. The evaporator coil shall be mounted in a stainless steel condensate drain pan.

E. DX-Refrigeration System:
1. All Refrigeration piping shall be refrigerant grade tubing. The refrigerant circuit shall include, as a minimum, refrigerant drier/strainer, sight glass with moisture detector, thermal expansion valve with rapid bleed port feature and external equalizer, evaporator coil, compressor, high pressure switch and manual reset and low pressure switch with automatic reset.

F. Compressors:

1. Each compressor shall be a high efficiency, high reliability and low sound scroll compressor.
2. The compressor shall be complete with:
   a. Charging and service schrader valve
   b. internal vibration isolation
   c. internal thermal overloads
   d. internal pressure relief valve
   e. internal discharge gas vibration eliminator
   f. external vibration mounting isolation
   g. external compressor sound jacket

G. Blowers & Motors:

1. The blower shall be direct driven, single inlet, two-fold backward curved radial fan with an electronically commutated motor for maintenance free operation.
2. The motor shall include: integrated electronic control board, soft-starting capabilities, and integrated current limitations.
3. The fan shall be low noise, low vibration manufactured with an anti-corrosive aluminum impeller. The fan impeller shall be dynamically and statically balanced in two planes to minimize vibration during operation.

H. Air Filtration:

1. The A/C shall have slide out, 2” deep, class 2 (per U.L. Standard 900) filters. The filters shall be easily accessed through a front access door. The filters shall have an efficiency rating of at least, 30% average as measured by ASHRAE Standard 52-76 test method.

I. DX Heat Rejection:

1. Each evaporator refrigerant circuit shall be provided with a factory installed single pass, counterflow configured brazed plate heat exchanger, with integral subcooler, constructed of type 316 stainless steel.

J. Unit Configuration:

1. Unit shall have back return inlet connection, top supply outlet connection, front service access, top piping and electrical connections and side condensate drain.

K. Controls

1. The unit shall be provided with a microprocessor based temperature and humidity controller with alarms. The controller shall incorporate a "user-friendly", menu driven, operating environment, to allow easy system setup and operation.
2. The controller shall include a graphic display. The graphic display shall indicate current unit functions: Cooling, Heating, Humidifying, Dehumidifying or Heating.
3. The controller shall maintain actual running hours of all the motor devices and operational cool times. These hours are displayed on demand. This feature assists in maintaining the control equipment in peak condition to minimize down time.

4. Alarm conditions shall activate an audible and visual indicator. The alarms are acknowledged through a dedicated alarm key located on the user interface. The controller shall generate alerts to the following alarm conditions (if applicable):
   a. High Temperature
   b. Dirty Filter
   c. Low Temperature
   d. Smoke Detection
   e. High Humidity
   f. Low Humidity
   g. High Head Press
   h. Sensor Failure
   i. Low Suction Press
   j. Loss of Air Flow

   Upon the receipt of any alarm, the alarm condition is displayed along with suggested operator actions to be taken. An audible tone and red LED is presented at time of the alarm occurrence.

5. The controller can be configured for Automatic or Manual Restart after a power failure event. Non-volatile memory shall enable the system to restart when power is restored, without the loss of any stored set points or other system configuration settings.

6. The controller has one (1) available non-powered dry contact that will activate if an alarm was configured to activate the common contact. The contact closes upon the receipt of the alarm and opens when the alarm condition has been cleared.

7. The controller shall incorporate a communication interface port that can be field connected through a serial interface to a Building Management System via BACnet over ETHERNET/IP as configured by the factory.

8. The controller shall have a temperature and humidity sensor, factory unit mounted in the return air stream of the Precision AC unit. The sensor is front accessible located directly beneath the return air filters.

9. A field installed supply air temperature and humidity sensor shall be provided for monitoring or controlling to supply air conditions. The controller shall provide a user adjustable supply air control set point if supply air control is active. The default information screen will indicate actual supply and return air properties. If dehumidification or humidification is required, the controller will control to the return air sensors humidity output. Reheating during dehumidification can utilize either the return or supply temperature conditions.

10. The controller shall include a user configurable temperature and humidity (relative humidity) or dew point control for dehumidification and humidification functions. When enabled for traditional relative humidity control, the controller continuously monitors the selected control sensors humidity (outdoor air or return air) to determine the activation of the humidifier or dehumidification functions. When enabled for dew point control, the controller continuously monitors the selected control sensors to compute the actual dew point conditions. The calculated dew point property is used to enable the humidifier or dehumidification functions which results in higher operational efficiency and shorter component usage.

11. The Unit shall be capable of the following precision:
   a. Supply Air Control Temperature Range: 50°F to 95.0°F
   b. Return Air Control Temperature Range: 68°F to 95.0°F
   c. Control Temperature Resolution: 0.2°F
   d. Control Temperature Tolerance: +/-1°
   e. Control Humidity Range: 20.0% to 70.0% RH
   f. Control Humidity Resolution: 0.1%
   g. Control Humidity Tolerance: +/-3%

L. Humidity Control
1. The humidifier shall be of a self-contained steam generating electrode type, utilizing a plastic disposable cylinder with full probes, connected to electric power via cylinder plugs that slide onto the electrode pins. The electrode pins shall be constructed from expanded low carbon steel, zinc plated, and dynamically formed for precise current control. The humidifier assembly shall include integral fill cup, fill and drain valves and associated piping. The canister shall be designed to collect the mineral deposits in the water and provide clean particle free steam to the air stream, thereby reducing maintenance cost. The microprocessor control shall maintain humidifier operation through fill and drain cycles based on the water conductivity. Overflow and loss of flow protection shall be provided along with a manual drain switch. A high water alarm with built-in time delay shall provide an indication to change canister. The humidification system shall require no cleaning maintenance during the cylinder life. The humidifier shall discharge steam at atmospheric pressure. It shall be capable of operating with water in the range of 200 to 1500 micromhos. The steam shall be introduced into the air stream, after the evaporator, by a calibrated discharge tube designed to equally distribute the steam to the air stream without condensation. The humidifier shall have a capacity of 4-10 lbs/hrs. Proportional (0-10 Vdc) microprocessor controls shall be provided with the Steam Generating Humidifier option.

M. Electric Heat
1. A factory mounted and wired low-watt density, plated fin-tubular design electric resistance heater shall be included to provide automatic sensible re-heating as required during the dehumidification cycle and automatic heating mode. Electric heaters shall be provided with miniature thermal/magnetic circuit breakers, which shall protect each ungrounded conductor. Also included will be one automatic reset and one manual reset over-temperature safety device (pilot duty).
2. The unit shall have the ability to control up to 3 stages of electric heat that is field installed external to the unit.

N. Smoke Detection
1. A photo-electric smoke detector shall be factory installed and wired in the return air section for unit over 2,000 cfm. The photo-electric detector shall include built-in circuitry that performs a functional test of all detection circuits at least once every 40 seconds without the need for generating smoke. The UL listed velocity range shall be 0-3000 fm. The air conditioner will shut down upon sensing smoke in the return air stream. The unit shall have the ability to connect to the building fire alarm system and generate and general alarm on detection of smoke.

2.04 CAPACITIES AND CHARACTERISTICS

A. See Drawings

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install HVAC units level and plumb, maintaining manufacturer’s recommended clearances. Install according to AHRI Guideline B.

B. HVAC Unit Mounting: Install using elastomeric pads. Comply with requirements for vibration isolation devices specified in Section 23 0548 “Vibration and Seismic Controls for HVAC.”
3.02 CONNECTIONS

A. Piping installation requirements are specified in other heating, ventilating, and air-conditioning Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to computer-room air conditioners, allow space for service and maintenance.

C. Drainage Connections: Comply with applicable requirements in Section 22 1116 "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.

3.03 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

   1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

D. After startup service and performance test, change filters and flush humidifier.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Refrigerant Piping
2. Refrigerant Pipe Insulation
3. Condensing Units
4. Heat Recovery / Branch Selector Boxes
5. Fancoil Units
6. VRF Coil Connection Kits
7. Controls

1.2 ACTION SUBMITTALS

A. Product Data:

1. Condensing Units
2. Branch Selector Boxes
3. Fancoil Units
4. Controls

B. Shop Drawings:

1. Factory approved design drawings that detail the relative arrangement of system components, refrigeration pipe sizes and lengths, and refrigerant charge requirements.
2. Factory approved wiring and control diagrams.

1.3 QUALITY ASSURANCE

A. If requested all bidders must submit references for three (3) successfully completed VRF system installations or similar size and complexity.

B. All components of the VRF system shall be installed by staff who have completed the VRF system manufacturer's installation and commissioning training. Submit certificates of training completion to the owner and engineer for review and approval prior to starting work. Any VRF system installation work completed by personal that have not completed factory installation and commissioning training will be considered non-conforming and will be rejected.

C. Engage a factory authorized representative to inspect the VRF system refrigeration system installation and submit a written report to the owner and engineer approving the installation prior to insulating or charging any portion of the VRF refrigerant piping system.

D. Engage a factory authorized representative to perform the initial VRF system start-up and written start-up report to the owner and engineer that approves the installation indicates that the system meets the manufacturer's installation and commissioning requirements.

ASHRAE: Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
1.4 WARRANTY

A. The warranty period shall begin once the VRF system start-up report has been reviewed and approved by the owner.

B. The warranty shall include all parts and associated labor as follows:

1. Refrigerant Compressors: 7 years
2. Field Fabricated Refrigerant Piping System: 3 years
3. All Other Components: 3 years

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. LG
2. Daikin

2.2 REFRIGERANT PIPING

A. The system shall be capable of refrigerant piping up to 390 actual feet from the condensing unit to the furthest indoor unit, a total combined liquid line length of 980 feet of piping between the condensing and fan coil units with 164 feet maximum vertical difference, without any oil traps.

B. Refrigerant piping shall be installed in accordance with the system manufacturer’s written instructions.

C. All refrigerant piping shall be Type ACR copper tube (hard or annealed) and comply with ASTM B 280, with wrought-copper fitting and unions that comply with ASME B16.22. Refrigerant piping 2” and larger shall be hard temper.

D. Refrigerant piping joints shall be brazed.

E. Refrigerant piping shall be supported with single swivel pipe rings, adjustable clevis hangers or trapeze hangers. Piping hung with swivel rings or clevis hangers shall have insulation shields. Each Pipe shall be supported separately – not in bundles. Piping installed in trapeze hangers shall be supported with Cooper B-line “Snap ‘N Shield” pipe supports or other approved equal.

2.3 REFRIGERANT PIPE INSULATION

A. All refrigerant piping shall be insulated with ¾” thick flexible closed cell elastomeric insulation. Refrigerant pipe insulation shall be continuous through all hangers and supports.

2.4 CONDENSING UNITS

A. Description: Water Source VRF Condensing Unit / Heat Pump Units with Heat Recovery.

B. General:

1. The condensing unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of Daikin scroll compressors, motors, brazed plate heat exchanger, electronic
expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and liquid receivers.

2. Discharge pressure gas line, liquid and suction lines must be individually insulated between the condensing and indoor units.

3. Discharge pressure gas line, liquid and suction lines must be individually insulated between the condensing and indoor units.

4. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.

5. Each condensing unit shall have a 240VAC, 0.3mA-0.5A control circuit output for water pump or isolation valve operation. This circuit shall be configured at commissioning to operate based on system or compressor operation.

6. The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.

7. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heater, fusible plug, overload relay, inverter overload protector, thermal protector for compressor motor, over current protection for the inverter and anti-recycling timer.

C. Cabinet:

1. The condensing unit shall be corrosion resistant. The unit shall be constructed from rust-proofed, mild steel panels coated with a baked enamel finish.

D. Condenser Heat Exchanger:

1. The condenser heat exchanger shall be a stainless brazed plate type designed for closed loop/dry cooler applications.

2. The heat exchanger shall have a maximum system water pressure of 285 psi (equivalent to 640ft of head).

E. Compressors:

1. Inverter scroll compressors shall be variable speed controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read and calculated. With each reading, the compressor capacity shall be controlled to eliminate deviation from target value.

2. The inverter driven compressor in each condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll with a maximum speed of 6,450 rpm.

3. The capacity control range shall be as low as 8% to 100%.

4. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.

5. Oil separators shall be standard with the equipment together with an intelligent oil management system.

6. The compressor shall be spring mounted to avoid the transmission of vibration.

7. Units sized 6-7 ton shall contain 1 compressor, 12-14 ton units shall contain 2 compressors and 18-21 ton units shall contain 3 compressors. In the event of compressor failure the remaining compressors shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be designed to specifically address this condition.

8. In the case of multiple condenser modules, conjoined operation hours of the compressors shall be balanced by means of the Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle or every 8 hours.
F. Operating Range:
   1. Inlet Water Temperature: 50-113°F.
   2. Ambient operating range for the condensing unit shall be between 35-104°F DB and 80% RH or lower (non-condensing).
   3. Heating/cooling Performance: See Drawings and Equipment Schedules
   4. Electrical Requirements: See Drawings and Equipment Schedules

2.5 HEAT RECOVERY / BRANCH SELECTOR BOXES

A. Description: Heat recovery / Branch Selector Boxes are used to control the mode, heating or cooling, of the indoor fancoil units and to allow heat recovery between branch selector boxes.

B. General:
   1. Heat recovery / branch selector boxes shall be factory assembled, wired, and piped.
   2. Heat recovery / branch selector boxes must be run tested at the factory.
   3. Heat recovery / branch selector boxes must be mounted indoors.
   4. When simultaneously heating and cooling, the units in heating mode shall energize their subcooling electronic expansion valve.

C. Cabinet:
   1. These units shall have a galvanized steel plate casing.
   2. The unit shall have sound absorption thermal insulation material made of flame and heat resistant foamed polyethylene.
   3. Heat recovery / branch selector boxes must have sound pressure levels below 50dB(A) when operating and 40 dB(A) when stopping.

D. Refrigeration Valves:
   1. The unit shall be furnished with 5 electronic expansion valves per branch to control the direction of refrigerant flow.
   2. The cabinet shall contain one subcooling heat exchanger per branch.
   3. The refrigerant connections must be of the braze type.
   4. See the plans and schedules for the fancoil units to be served from each heat branch selector box. Install all refrigerant piping from the condensing units and the branch selector boxes and between the branch selector boxes and the indoor fancoil units.

E. Electrical:
   1. See the plans for additional information.
   2. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
   3. The unit shall be capable of operation within the limits of 187 volts to 255 volts.
   4. The minimum circuit amps (MCA) shall be 0.1 and the maximum overcurrent protection amps (MOP) shall be 15.
   5. The control voltage between the condensing unit and heat recovery / branch selector boxes shall be 16VDC non-shielded 2 conductor cable.

2.6 INDOOR FANCOIL UNITS

A. Description:
   1. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan
motor thermal protector, flare connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an adjustable external static pressure switch.

2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the condensing unit.

B. Unit Type:
1. Provide fancoil units of the type and style listed in VRF Fancoil Schedule.

C. Fan:
1. The airflow rate shall be available in high and low settings.
2. The fan motor shall be thermally protected.
3. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
4. Fan motors shall be ECM.

D. Filter
1. Exposed ductless units shall have a washable long-life filter with mildew proof resin.
2. Concealed and ducted units shall have a field fabricated filter rack on the return air inlet to house a 2” pleated MERV-8 filter. The filter rack and filter shall be sized for a max filter velocity of 400 fpm.

E. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. A condensate pan shall be located under the coil.
3. Where indicated on the plans, a condensate pump with an 18-3/8” lift shall be located below the coil in the condensate pan with a built in safety alarm.

F. Electrical:
1. Each fancoil unit requires a 208/230 volts, 1 phase, 60 hertz power supply with local toggle type disconnect switch. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

G. Control:
1. The unit shall have integral controls provided by the manufacturer to perform input functions necessary to operate the system.
2. The unit shall include a wall mounted, hard wired remote sensor.
3. The unit shall be compatible with factory provided central management and control system that allows remote monitoring and adjustment via a local touch screen panel or a web base interface.
2.7 VRF COIL CONNECTION KITS
A. VRF Coil Connection Kits allow air handling units with Heat Pump coils to be connected to the VRF system. The kit includes a an expansion valve box, a control box and a thermistors that are filed installed on the refrigerant liquid and refrigerant gas connections to the Heat Pump Coil.
B. Control: A 0-10V cooling demand signal is supplied from the BMS system to the control box to control the discharge air temperature from the heat pump coil.
C. Operating Conditions: The entering temperature to the heat pump coil should remain within the following limitations:
   1. Cooling Operation: Maximum 95F DB / 77F WB
   2. Heating Operation: Minimum 50F DB
D. Refrigerant Piping:
   1. Max length from condensing unit to heat pump coil: 164 ft
   2. Min length from condensing unit to heat pump coil: 16.4 ft
   3. Max length from valve box to heat pump coil: 16.4 ft
   4. Max elevation difference from valve box to heat pump coil: +/-16.4 ft

2.8 VRF SYSTEM CONTROLS
A. All new VRF system components shall be integrated into the existing Daikin Intelligent Control System.
B. The existing Daikin BACnet interface shall be connected to the building management system to allow monitoring of the VRF system remotely via a web based user interface. See Sections 230900 and 230993 for additional information.

PART 3 - EXECUTION
3.1 INSTALLATION
A. All VRF system components shall be furnished installed by the mechanical contractor. Install all VRF system components per the manufacturer's instructions and requirements.
   1. Install all units level and plumb.
   2. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
   3. Install seismic restraints.
   4. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch. See Section 23 0548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
   5. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
B. CONNECTIONS
   1. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
   2. Duct Connections: Duct installation requirements are specified in Section 23 3113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return
ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 23 3300 "Air Duct Accessories.

C. REFRIGERANT PIPING

1. Suction Lines for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
3. Safety-Relief-Valve Discharge Piping: Copper, Type ACR and wrought-copper fittings with soldered joints.
4. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
5. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
6. Install Flexible connectors at compressors and connection to condensing units.
7. Install isolation valves with charging ports in piping connection to all branch selector boxes.
8. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
9. 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.
10. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
11. Install piping adjacent to machines to allow service and maintenance.
12. Install piping adjacent to machines to allow service and maintenance.
13. Select system components with pressure rating equal to or greater than system operating pressure.
14. Slope refrigerant piping as follows:
   a. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
   b. Install horizontal suction lines with a uniform slope downward to compressor.
   c. Install traps and double risers to entrain oil in vertical runs.
   d. Liquid lines may be installed level.
15. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
16. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
17. Identify refrigerant piping and valves according to Section "Identification for HVAC Piping and Equipment."
18. Install sleeves for piping penetrations of walls, ceilings, and floors.
19. Install sleeve seals for piping penetrations of concrete walls and slabs.
20. Install escutcheons for piping penetrations of walls, ceilings, and floors.
21. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes.
   a. NPS 1/4: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   b. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   c. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   d. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
   e. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   f. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   g. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
22. Charge system using the following procedures:
   a. Install core in filter dryers after leak test but before evacuation.
   b. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
   c. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
   d. Charge system with a new filter-dryer core in charging line.

3.2 REFRIGERANT LEAK DETECTION
A. Where required by the International Mechanical Code or ASHRAE Standard 15, install a refrigerant leak detection system. Coordinate location of all system components with the architect and engineer prior to installation.

3.3 FIELD QUALITY CONTROL
A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
   B. Tests and Inspections:
      1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
      2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Remove and replace malfunctioning units and retest as specified above. Prepare test and inspection reports.

3.4 DEMONSTRATION
A. Engage a factory authorized representative to train the owner and owner’s personnel to operate the system, controls and perform basic maintenance.
   B. END OF SECTION 23 3113
SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. Section Includes:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES
A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Alcan Products Corporation; Alcan Cable Division.
   2. Alpha Wire.
   3. Belden Inc.
   5. General Cable Technologies Corporation.
B. Aluminum and Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658. For aluminum conductors also comply with NECA/AA 104-2000 “Recommended Practice for Installing Aluminum Building Wire and Cable”.
C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THW-2 Type THHN-2-THWN-2 Type XHHW-2 Type UF Type USE and Type SO.
D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC nonmetallic-sheathed cable, Type NM Type SO and Type USE with ground wire.

2.2 CONNECTORS AND SPLICES
A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. AFC Cable Systems, Inc.
2. Gardner Bender.
4. Ideal Industries, Inc.
5. Ilsco; a branch of Bardes Corporation.
6. NSi Industries LLC.
7. O-Z/Gedney; a brand of the EGS Electrical Group.
8. 3M; Electrical Markets Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway Type SER or Type USE multi-conductor cable.

B. Feeders: Type THHN-2-THWN-2, single conductors in raceway Metal-clad cable, Type MC Nonmetallic-sheathed cable, Type NM.

C. Branch Circuits: Type THHN-2-THWN-2, single conductors in raceway Metal-clad cable, Type MC [Nonmetallic-sheathed cable, Type NM.

D. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 26 0533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 26 0529 "Hangers and Supports for Electrical Systems."

G. Provide a dedicated neutral conductor for each 120v branch circuit.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 0553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Perform each visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

B. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 0519
SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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. Section Includes: Grounding systems and equipment.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS
   A. Informational Submittals: Plans showing dimensioned as-built locations of grounding features
      specified in "Field Quality Control" Article, including the following:
      1. Test wells.
      2. Ground rods.
      3. Ground rings.
   B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For grounding to include in emergency, operation, and
      maintenance manuals. In addition to items specified in Section 01 7823 "Operation and
      Maintenance Data," include the following:
      1. Instructions for periodic testing and inspection of grounding features based on
         NETA MTS.
         a. Tests shall determine if ground-resistance or impedance values remain within
            specified maximums, and instructions shall recommend corrective action if values do not.
         b. Include recommended testing intervals.

1.6 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
      by a qualified testing agency, and marked for intended location and application.
   B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS
   A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by
      applicable Code or authorities having jurisdiction.
B. Bare Copper Conductors:
   4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
   5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
   7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.2 CONNECTORS
A. Listed and labeled by an NRTL 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, pressure type with at least two bolts.
   1. Pipe Connectors: Clamp type, sized for pipe.
C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES
A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet in diameter.

PART 3 - EXECUTION
3.1 APPLICATIONS
A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.
B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
   1. Bury at least 24 inches below grade.
C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
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 at Test Wells: Bolted connectors.


3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.3 EQUIPMENT GROUNDING

A. Install green insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Bond equipment grounding conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Bond equipment grounding conductor to heater units, piping, connected equipment, and components.

D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, where the equipment enclosure is isolated from the supply circuit with a nonmetallic raceway, install a fitting listed for the purpose, where raceway enters enclosure, and bond to the insulated equipment grounding conductor. Bond the conductor to the isolated equipment enclosure, and terminate at the equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

E. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode
system to each service location, terminal cabinet, wiring closet, and central equipment location, unless noted otherwise.

2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.

3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

F. Poles Supporting Outdoor Lighting Fixtures: DO NOT install a grounding electrode and a separate insulated equipment grounding conductor at these locations. Bond the equipment grounding conductor installed with branch-circuit conductors to the grounding terminal at the pole base.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with a lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

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 2 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.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. **Water Meter Piping:** Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. **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.

G. **Ufer Ground (Concrete-Encased Grounding Electrode):** Fabricate according to NFPA 70, and as detailed on drawings. If drawing does not provide Ufer ground detail install the grounding electrode as defined below:
   1. Use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
   2. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
   3. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

H. **Structural Steel:** When available, bond structural steel to grounding electrode system, according to NFPA 70.

### 3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. **Tests and Inspections:**
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
   3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
      a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method according to IEEE 81.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Report measured ground resistances that exceed 25 ohms to ground.

E. **Excessive Ground Resistance:** If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
END OF SECTION 26 0526
SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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 Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.
B. Related Sections include the following:
   1. Section 26 0548 "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS
A. EMT: Electrical metallic tubing.
B. IMC: Intermediate metal conduit.
C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS
A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 QUALITY ASSURANCE
A. Comply with NFPA 70.

1.6 COORDINATION
A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.
B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS
A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut; Tyco International, Ltd.
   g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch-diameter holes at a maximum of 8 inches o.c., in at least 1 surface.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. Fabco Plastics Wholesale Limited.
   d. Seasafe, Inc.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.

3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.

4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.


2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 05 5000 "Metal Fabrications" for steel shapes and plates.
PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
   6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
   7. To Light Steel: Sheet metal screws.
   8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete.

C. Anchor equipment to concrete base.
   1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION 26 0529
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. Section includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
7. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.
B. GRC: Galvanized rigid steel conduit.
C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney; a brand of EGS Electrical Group.
6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
7. Republic Conduit.
8. Robroy Industries.
10. Thomas & Betts Corporation.
11. Western Tube and Conduit Corporation.
12. Wheatland Tube Company; a division of John Maneely Company.
B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   1. Comply with NEMA RN 1.
   2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; zinc-coated steel or aluminum.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
   1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
   2. Fittings for EMT:
      a. Material: Steel.
      b. Type: Setscrew.
   3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
   4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. AFC Cable Systems, Inc.
   2. Anamet Electrical, Inc.
   3. Arnco Corporation.
   4. CANTEX Inc.
   5. CertainTeed Corp.
   7. Electri-Flex Company.
   8. Kraloy.
   9. Lamson & Sessions; Carlon Electrical Products.
   10. Niedax-Kleinhuis USA, Inc.
   11. RACO; a Hubbell company.
12. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC or Type EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Rigid HDPE: Comply with UL 651A.

G. Continuous HDPE: Comply with UL 651B.

H. RTRC: Comply with UL 1684A and NEMA TC 14.

I. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

J. Fittings for LFNC: Comply with UL 514B.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Hoffman; a Pentair company.
4. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 Type 3R, Type 4, and Type 12 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allied Moulded Products, Inc.
3. Lamson & Sessions; Carlon Electrical Products.
4. Niedax-Kleinhuis USA, Inc.

B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

2.5 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Mono-Systems, Inc.
   b. Panduit Corp.
   c. Wiremold / Legrand.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Hubbell Incorporated; Wiring Device-Kellems Division.
   b. Mono-Systems, Inc.
   c. Panduit Corp.
   d. Wiremold / Legrand.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Technologies Company; Cooper Crouse-Hinds.
2. EGS/Appleton Electric.
5. **Hubbell Incorporated; Killark Division.**  
6. **Kraloy.**  
7. **Milbank Manufacturing Co.**  
8. **Mono-Systems, Inc.**  
9. **O-Z/Gedney; a brand of EGS Electrical Group.**  
10. **RACO; a Hubbell Company.**  
11. **Robroy Industries.**  
12. **Stahlin Non-Metallic Enclosures; a division of Robroy Industries.**  
13. **Thomas & Betts Corporation.**  
14. **Wiremold / Legrand.**

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:
   1. Material: Cast metal.  
   2. Type: Fully adjustable.  
   3. Shape: Rectangular.  
   4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, round.
   1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).
   1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
M. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep). 4 inches square by 1-1/4 inches deep is permitted in shallow 2” framed walls.

N. Gangable boxes are allowed for 6 gang or larger.

O. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R, Type 4, and Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

P. Cabinets:

1. NEMA 250, Type 1, Type 3R, and Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armorcast Products Company.
   b. Carson Industries LLC.
   d. NewBasis.
   e. Nordic Fiberglass, Inc.
   f. Oldcastle Precast, Inc.; Christy Concrete Products.
   g. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
   h. Quazite (Hubbell).

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC." Or "COM" as indicated on drawings.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC .
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC in fine bedded trench.
4. Under roadways and paved or concrete walkways: Type EPC-80-PVC in fine bedded trench.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Severe Physical Damage: EMT.
2. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.
3. Concealed in Ceilings and Interior Walls and Partitions: EMT or as specifies in 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. .
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: GRC.
6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 nonmetallic in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting
manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz, and for protecting bare grounding conductors. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm) of enclosures to which attached.

I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.

4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from RNC, Type EPC-40-PVC, to a GRC bend and thru slab stub before rising above floor.

J. Stub-ups to Above Recessed Ceilings:
   1. Use EMT, IMC, or GRC for raceways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

R. Surface Raceways:
   1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
   2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where an underground service raceway enters a building or structure.
   3. Where otherwise required by NFPA 70.
U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

V. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   d. Attics: 135 deg F (75 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Locate boxes so that cover or plate will not span different building finishes.
BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

EE. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:
   1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified for pipe less than 6 inches (150 mm) in nominal diameter.
   2. Install backfill as specified.
   3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified.
   4. Install manufactured duct elbows for stub-ups at poles and equipment unless otherwise indicated. Install manufactured rigid steel conduit elbows at building entrances through floor.
      a. Couple steel conduits to ducts with adapters designed for this purpose.
      b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
   5. Underground Warning Tape: Comply with requirements in Section 26 0553 "Identification for Electrical Systems."

### 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS
   A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies

3.6 FIRESTOPPING
   A. Install fire-stopping at penetrations of fire-rated floor and wall assemblies.

3.7 PROTECTION
   A. Protect coatings, finishes, and cabinets from damage and deterioration.
      1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
      2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 0533
SECTION 26 0548
VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes:
   1. Isolation pads.
   2. Channel support systems.
   3. Restraint cables.

1.2 PERFORMANCE REQUIREMENTS
A. Seismic-Restraint Loading:
   1. Site Class as Defined in the IBC: See Structural Specifications
   2. Assigned Seismic Use Group or Building Category as Defined in the IBC: See Structural Specifications
      a. Component Response Modification Factor: As per ASCE 7-08 Table 13.6-1, current edition
      b. Component Amplification Factor: As per ASCE 7-08 Table 13.6-1, current edition
   3. Design Spectral Response Acceleration at Short Periods (0.2 Second): See Structural Specifications
   4. Design Spectral Response Acceleration at 1.0-Second Period: See Structural Specifications

1.3 QUALITY ASSURANCE
A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS
A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Isolation Technology, Inc.
   3. Mason Industries.
   4. Vibration Eliminator Co., Inc.
   5. Vibration Isolation.
   6. Vibration Mountings & Controls, Inc.
B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
   1. Resilient Material: Oil- and water-resistant neoprene.

2.2 SEISMIC-RESTRAINT DEVICES
A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Cooper B-Line, Inc.; a division of Cooper Industries.
   2. Hilti Inc.
   3. Mason Industries.
4. **Unistrut; Tyco International, Ltd.**

B. **General Requirements for Restraint Components:** Rated strengths, features, and application requirements 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.

C. **Channel Support System:** MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. **Hanger Rod Stiffener:** Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.

E. **Bushings for Floor-Mounted Equipment Anchor:** Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

F. **Bushing Assemblies for Wall-Mounted Equipment Anchorage:** Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

G. **Resilient Isolation Washers and Bushings:** One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

H. **Mechanical Anchor:** Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

I. **Adhesive Anchor:** Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

### 2.3 FACTORY FINISHES

A. **Finish:** Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

A. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLICATIONS

A. **Multiple Raceways or Cables:** Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. **Strength of Support and Seismic-Restraint Assemblies:** Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.
3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:
   1. Install restrained isolators on electrical equipment.
   2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer's recommended torque, using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.
B. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 26 0548
SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

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. Section Includes:
   1. Identification for conductors.
   2. Underground-line warning tape.
   3. Instruction signs.
   4. Equipment identification labels.
   5. Miscellaneous identification products.

1.3 QUALITY ASSURANCE
A. Comply with ANSI A13.1.
B. Comply with NFPA 70.
D. Comply with ANSI Z535.4 for safety signs and labels.
E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.4 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 CONDUCTOR IDENTIFICATION MATERIALS
A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
2.2 UNDERGROUND-LINE WARNING TAPE

A. Tape:
   1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
   2. Printing on tape shall be permanent and shall not be damaged by burial operations.
   3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:
   1. Comply with ANSI Z535.1 through ANSI Z535.5.
   2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
   3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Type:
   1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
   2. Overall Thickness: 5 mils.
   3. Foil Core Thickness: 0.35 mil.
   5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

2.3 WARNING LABELS AND SIGNS


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. 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."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.4 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 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 at applicable equipment.

2.5 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 1/2 inch.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 1/2 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 1/2 inch.

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 1/2 inch.

2.6 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
   3. UL 94 Flame Rating: 94V-0.
   4. Temperature Range: Minus 50 to plus 284 deg F.
   5. Color: Black.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in 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 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.

2. In Spaces Handling Environmental Air: Plenum rated.

G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

H. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with paint as follows:

1. Fire Detection and Alarm System: Red

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

   a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.

   b. Colors for 240/120-V Circuits:

      1) Phase A: Black.

      2) Phase B: Red.

      3) Neutral: White.

   c. Colors for 208/120-V Circuits:
1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.
4) Neutral: White.

d. Colors for 480/277-V Circuits:
   1) Phase A: Brown.
   2) Phase B: Orange.
   3) Phase C: Yellow.
   4) Neutral: Gray.

e. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

E. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.

F. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
   1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
   2. Identify system voltage with black letters on an orange background.
   3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
   a. Power transfer switches.
   b. Controls with external control power connections.

J. 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.

K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer and load shedding.

L. 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: Self-adhesive, 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 to those appropriate for viewing from the floor.
   d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:
   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label. Panelboard identification shall include: Identification name, voltage, source and available fault current with date calculated.
      1) On main distribution panel door provide a laminated one-line diagram of panel configurations if applicable.
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Switchgear.
   e. Switchboards.
   f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
g. Substations.
h. Emergency system boxes and enclosures.
i. Motor-control centers.
j. Enclosed switches.
k. Enclosed circuit breakers.
l. Enclosed controllers.
m. Variable-speed controllers.
n. Push-button stations.
o. Power transfer equipment.
p. Contactors.
q. Remote-controlled switches, dimmer modules, and control devices.
r. Battery-inverter units.
s. Battery racks.
t. Power-generating units.
u. Monitoring and control equipment.
v. UPS equipment.
w. Wiring devices: See specification section “Wiring Devices”.

END OF SECTION 26 0553
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   2. Indoor occupancy and switchbox-mounted occupancy sensors.

   B. Related Requirements:

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data

PART 2 - PRODUCTS

2.1 TIME SWITCHES / LIGHTING CONTROL PANEL

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Cooper Industries, Inc.
   2. Intermatic, Inc.
   3. Invensys Controls.
   4. Wattstopper
   5. Leviton Manufacturing Co., Inc.
   6. NSi Industries LLC.
   7. Tyco Electronics Corporation; a TE Connectivity Ltd. company.

B. Electronic Lighting Control Panel – Programmable Astronomical Timeclock: Solid state, programmable, with alphanumeric display; complying with UL 917.
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Contact Configuration: SPST.
   3. Contact Rating: 30-A inductive or resistive, 240-V ac.
4. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.

5. Programs: Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.

6. Programs: 8 channels; each channel is individually programmable with eight on-off set points on a 24-hour schedule.

7. Programs: 8 channels; each channel is individually programmable with two on-off set points on a 24-hour schedule with a skip-a-day weekly schedule.

8. Programs: 8 channels; each channel is individually programmable with two on-off set points on a 24-hour schedule, allowing different set points for each day of the week.

9. Programs: 8 channels; each channel is individually programmable with 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.

10. Programs: 8 channels; each channel is individually programmable with 40 on-off operations per week, plus four seasonal schedules that modify the basic program, and an annual holiday schedule that overrides the weekly operation on holidays.

11. Programs: an annual holiday schedule that overrides the weekly operation on holidays.

12. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.

13. Astronomic Time: All channels.


15. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.

2. Leviton Manufacturing Co., Inc.

3. Lithonia Lighting; Acuity Brands Lighting, Inc.

4. Lutron Electronics Co., Inc.

5. Philips Lighting Controls.

6. Watt Stopper.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.

4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

5. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.

7. Bypass Switch: Override the "on" function in case of sensor failure.

8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

   1. Sensitivity Adjustment: Separate for each sensing technology.
   2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
   3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Cooper Industries, Inc.
   2. Leviton Manufacturing Co., Inc.
   3. Lithonia Lighting; Acuity Brands Lighting, Inc.
   4. Lutron Electronics Co., Inc.
   5. Philips Lighting Controls.
   6. Watt Stopper.
2.4 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Mult-conductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

B. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

C. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

D. Wiring Method: Comply with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

E. Identify components and power and control wiring according to Section 26 0553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Lighting control devices will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 26 0923
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. Section Includes:
   1. Lighting and appliance branch-circuit panelboards.
   2. Load centers.

1.3 DEFINITIONS

1.4 PERFORMANCE REQUIREMENTS
A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS
A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types and details for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Short-circuit current rating of panelboards and overcurrent protective devices.
   5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   6. Include wiring diagrams for power, signal, and control wiring.
   7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.6 INFORMATIONAL SUBMITTALS
A. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 26 0548 "Vibration and Seismic Controls for Electrical Systems."
B. Panelboard Schedules: For installation in panelboards.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.

1.9 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.11 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Construction Manager's written permission.
3. Comply with NFPA 70E.

1.12 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 26 0548 “Vibration and Seismic Controls for Electrical Systems.”

B. Enclosures: Flush- and surface-mounted cabinets.
1. Rated for environmental conditions at installed location.
   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3R.
   c. Kitchen and Wash-Down Areas: NEMA 250, Type 4X.
   d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

3. Finishes:
a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.


C. Incoming Mains Location: Top and bottom

D. Phase, Neutral, and Ground Buses:
   2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

E. Conductor Connectors: Suitable for use with conductor material and sizes.
   2. Main and Neutral Lugs: Mechanical type.
   3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
   4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
   5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
   6. Gutter-Tap Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.


2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: As required on Drawings.

D. Branch Overcurrent Protective Devices: Plug-in or Bolt-on circuit breakers, replaceable without disturbing adjacent units.
E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.3 LOAD CENTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   3. Square D; a brand of Schneider Electric.

B. Load Centers: Comply with UL 67.

C. Mains: As required on Drawings.

D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

E. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   3. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
   3. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
   4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
      a. Standard frame sizes, trip ratings, and number of poles.
      b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
      c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
2.5 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Equipment Mounting: When installing panelboards on concrete bases, they shall be 4-inch nominal thickness. Comply with requirements for concrete base specified.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.

2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to panelboards.

5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Section 26 0548 "Vibration and Seismic Controls for Electrical Systems."

E. Mount top of trim 90 inches above finished floor unless otherwise indicated.

F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Install overcurrent protective devices and controllers not already factory installed.

H. Install filler plates in unused spaces.

I. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

J. Comply with NECA 1.
3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 0553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as recommended by the manufacturer. Provide manufacturer's recommendations and set all adjustable breakers to ensure downstream breakers have a sufficient amount of time to clear faults.

END OF SECTION 26 2416
SECTION 26 2726
WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Receptacles, receptacles with integral GFCI, and associated device plates.
   2. Weather-resistant receptacles.
   3. Snap switches and wall-box dimmers.
   4. Solid-state fan speed controls.
   5. Wall-switch and exterior occupancy sensors.
   6. Communications outlets.

1.2 ADMINISTRATIVE REQUIREMENTS
A. Coordination:
   1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS
A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers’ Names: Shortened versions (shown in parentheses) of the following manufacturers’ names are used in other Part 2 articles:
   1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
   2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS
A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with NFPA 70.
C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper; 5351 (single), CR5362 (duplex).
   b. Hubbell; HBL5351 (single), HBL5352 (duplex).
   c. Leviton; 5891 (single), 5352 (duplex).
   d. Pass & Seymour; 5361 (single), 5362 (duplex).

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper; VGF20.
   b. Hubbell; GFR5352L.
   c. Pass & Seymour; 2095.
   d. Leviton; 7590.

2.5 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Single Pole:
      1) Cooper; AH1221.
2) Hubbell; HBL1221.
3) Leviton; 1221-2.
4) Pass & Seymour; CSB20AC1.

b. Two Pole:
1) Cooper; AH1222.
2) Hubbell; HBL1222.
3) Leviton; 1222-2.
4) Pass & Seymour; CSB20AC2.

c. Three Way:
1) Cooper; AH1223.
2) Hubbell; HBL1223.
3) Leviton; 1223-2.
4) Pass & Seymour; CSB20AC3.

d. Four Way:
1) Cooper; AH1224.
2) Hubbell; HBL1224.
3) Leviton; 1224-2.
   Pass & Seymour; CSB20AC4.

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.

C. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness. Dimmer shall match ballast low end capability as called out on the drawings.

2.7 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: Smooth, high-impact thermoplastic [0.035-inch-thick, satin-finished, Type 302 stainless steel] [0.05-inch-thick, anodized aluminum].
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof while in-use Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.8 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Almond unless otherwise indicated or required by NFPA 70 or device listing.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.

2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
   1. Install ground pin of vertically mounted receptacles up and on horizontally mounted receptacles to the left.

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. Verify that dimmers used for fan speed control are listed for that application.
   3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers’ device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test Instruments: Use instruments that comply with UL 1436.
   2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:
   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

3.4 IDENTIFICATION

A. Receptacles: Identify panelboard and circuit number from which the device is served. Use hot, stamped or engraved machine printing with black-filled 1/8” lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.5 WEATHERSTRIPPING

A. Behind exterior wall devices

1. Install a precut foam insulation pad over the fixture and reinstall the cover.

END OF SECTION 26 2726
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. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, panelboards, switchboards, enclosed controllers and motor-control centers.
2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
   a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer’s ambient temperature adjustment factors to fuse ratings.

1.8 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch-high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.
PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS
A. Cartridge Fuses:
   1. Feeders and Equipment Branch Circuits: Class RK5, time delay.
   2. Control Circuits: Class CC, time delay.

3.3 INSTALLATION
A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
B. Install spare-fuse cabinet(s). Verify exact location(s) with Owner’s maintenance representative prior to mounting.

3.4 IDENTIFICATION
A. Install labels complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 2813
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Fusible switches.
   2. Non-fusible switches.
   3. Molded-case circuit breakers (MCCBs).
   4. Enclosures.

1.2 DEFINITIONS
A. NC: Normally closed.
B. NO: Normally open.
C. SPDT: Single pole, double throw.

1.3 PERFORMANCE REQUIREMENTS
A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 ACTION SUBMITTALS
A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS
A. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS
A. Operation and maintenance data.

1.7 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.


D. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

E. Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Suitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for switching fluorescent and high-intensity discharge lighting circuits.
   4. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
   5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
   6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
   7. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 26 0548 "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.2 IDENTIFICATION

A. Comply with requirements in Section 26 0553 "Identification for Electrical Systems."

   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

   1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.

   2. Test continuity of each circuit.

C. Tests and Inspections:

   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 2816
SECTION 26 5100
LIGHTING

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. Section Includes:
   1. Emergency lighting units.
   2. Exit signs.
   3. Lighting fixture supports.

B. Related Sections:
   1. Section 26 0923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
   2. Section 265119 LED Lighting
   3. Section 26 2726 "Wiring Devices".

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature.

C. CRI: Color-rendering index.

D. LER: Luminaire efficacy rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 PRIOR APPROVAL

A. Prior approvals are not required unless otherwise noted on the Luminaire Schedule.

   1. All material supplied to the project must meet or exceed the quality, performance, and have similar features to the product originally specified. It is the contractor's responsibility to ensure that substituted equipment matches the exterior dimensions, weight, and configuration of the specified equipment.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged 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.
4. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
   a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Installation instructions.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
   2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
   3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. 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.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.9 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, and partition assemblies.

B. Fire rated assemblies: Fixtures installed in fire rated assemblies shall maintain the fire rating of said assembly. Contractor is required to coordinate with Architectural draws to verify assembly ratings.
C. Insulated ceiling space: Fixtures installed in an insulated ceiling be IC rated or manufacturer recommended clearances between fixture and insulation. Contractor is required to coordinate with Architectural draws to verify insulated areas above ceilings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

E. 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.

F. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent 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 (3.175 mm) minimum unless otherwise indicated.
   b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:
   a. "USE ONLY" and include specific lamp type.
   b. Lamp diameter code (T-4, T-5, T-8, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
   c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
   d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
   e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
   f. CCT and CRI for all luminaires.
H. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:

1. Comply with UL 935 and with ANSI C82.11.
2. Designed for type and quantity of lamps served.
3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating: Less than 10 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Operating Frequency: 42 kHz or higher.
8. Lamp Current Crest Factor: 1.7 or less.
9. BF: 0.88 or higher.
10. Power Factor: 0.95 or higher.

B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.

C. Electronic Programmed-Start Ballasts for T5 and T5HO Lamps: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.

D. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.


E. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.

F. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
4. Control: Coordinate wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.

G. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.

1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
   a. High-Level Operation: 100 percent of rated lamp lumens.
b. Low-Level Operation: 50 percent of rated lamp lumens.

2. Ballast shall provide equal current to each lamp in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

2.4 EXIT SIGNS

A. General Requirements for Exit Signs: 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: LEDs, 50,000 hours minimum rated lamp life.

2.5 EMERGENCY LIGHTING UNITS

A. LED

B. UL 924 90minute battery

2.6 LED Assemblies

A. Products UL rated for 40 degree C (104 degrees F) ambient environments.

B. Minimum 4000K color temperature unless noted otherwise in the drawings.

C. 50,000 hour fixture life including driver, 5 year warranty.

D. All products compliant with EISNA LM-79 and LM-80 standards.

2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 26 0529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

E. Rod Hangers: 3/16-inch (5-mm) 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:
   1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
   1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches (150 mm) 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 (20-mm) metal channels spanning and secured to ceiling tees.
   4. Install at least two independent support rods or wires 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.

E. Suspended Lighting Fixture Support:
   1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
   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.
   4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Connect wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.3 INSULATED CEILING SPACES

A. Provide IC rated fixture assemblies or manufacturer recommended clearances between fixture and insulation.

3.4 FIRE RATED ASSEMBLIES

A. Provide fire rated fixture assemblies or a third party fire rated cover.
   1. Fire rated covers
a. Provide manufacturer recommended clearances for all non IC rated fixtures.

3.5 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.

3.6 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

END OF SECTION 26 5100
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior solid-state luminaires that use LED technology.
   2. Lighting fixture supports.

B. Related Requirements:
   1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
   2. Section 260926 "Lighting Control Panelboards" for panelboards used for lighting control.
   3. Section 260933 "Central Dimming Controls" or Section 260936 "Modular Dimming Controls" for architectural dimming systems and for fluorescent dimming controls with dimming ballasts specified in interior lighting Sections.
   4. Section 260943.16 "Addressable-Luminaire Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.
B. CRI: Color Rendering Index.
C. Fixture: See "Luminaire."
D. IP: International Protection or Ingress Protection Rating.
E. LED: Light-emitting diode.
F. Lumen: Measured output of lamp and luminaire, or both.
G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, arranged by designation.
B. Shop Drawings: For nonstandard or custom luminaires.
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Sustainable Design Submittals:

D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved:

B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

C. Product Certificates: For each type of luminaire.

D. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. Recessed Fixtures: Comply with NEMA LE 4.
E. CRI of minimum 80. CCT of 3000 K.
F. Rated lamp life of 50,000 hours.
G. Lamps dimmable from 100 percent to 0 percent of maximum light output.
H. Internal driver.
I. Nominal Operating Voltage: 120v and 277 V ac.
   1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
J. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. Clear or painted finish.

2.3 CYLINDER
A. Minimum 1000 lumens. Minimum allowable efficacy of 80 lumens per watt.
B. With integral mounting provisions.

2.4 RECESSED TROFFER
A. Minimum 1,500 lumens. Minimum allowable efficacy of 85 lumens per watt.
B. Integral junction box with conduit fittings.

2.5 STRIP LIGHT
A. Minimum 750 lumens. Minimum allowable efficacy of 75 lumens per watt.
B. Integral junction box with conduit fittings.

2.6 SURFACE MOUNT, LINEAR
A. Minimum 750 lumens. Minimum allowable efficacy of 75 lumens per watt.
B. Integral junction box with conduit fittings.

2.7 SURFACE MOUNT, NONLINEAR
A. Minimum 750 lumens. Minimum allowable efficacy of 75 lumens per watt.
B. Integral junction box with conduit fittings.

2.8 SUSPENDED, LINEAR
A. Minimum 1,500 lumens. Minimum allowable efficacy of 85 lumens per watt.

2.9 SUSPENDED, NONLINEAR
A. Minimum 1,500 lumens. Minimum allowable efficacy of 85 lumens per watt.
B. Integral junction box with conduit fittings.
2.10 MATERIALS

A. Metal Parts:
   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging

B. 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.

C. Diffusers, and Globes:
   1. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   2. Glass: Annealed crystal glass unless otherwise indicated.
   3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

D. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. Clear or painted finish.

2.11 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.12 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.
B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports: Sized and rated for luminaire weight.

E. Flush-Mounted Luminaire Support: Secured to outlet box.

F. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls, attached to a minimum 20 gauge backing plate attached to wall structural members, attached using through bolts and backing plates on either side of wall.
   2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:
   1. Ceiling mount with two 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.
   2. Ceiling mount with pendant mount with 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.
   3. Ceiling mount with hook mount.

H. Suspended Luminaire Support:
   1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
   3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod wire support for suspension for each unit length of luminaire chassis, including one at each end.
   4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:
   1. Secure to any required outlet box.
   2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

K. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265119
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal conduits and fittings.
   2. Nonmetallic conduits and fittings.
   3. Surface pathways.
   5. Handholes and boxes for exterior underground cabling.

B. Related Requirements:
   1. Section 26 0533 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.

1.2 ACTION SUBMITTALS

A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. LEED Submittals:
   1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
   2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For custom enclosures and cabinets.

1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, equipment racks and their mounting provisions, including those for internal components, from manufacturer.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. General Requirements for Metal Conduits and Fittings:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with TIA-569-B.
B. GRC: Comply with ANSI C80.1 and UL 6.

C. ARC: Comply with ANSI C80.5 and UL 6A.

D. EMT: Comply with ANSI C80.3 and UL 797.

E. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
   1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
   2. Fittings for EMT:
      a. Material: Steel or die cast.
      b. Type: Setscrew or compression.
   3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.

F. Joint Compound for GRC or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. General Requirements for Nonmetallic Conduits and Fittings:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with TIA-569-B.

B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

C. Continuous HDPE: Comply with UL 651B.

D. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

E. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 SURFACE PATHWAYS

A. General Requirements for Surface Pathways:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with TIA-569-B.

B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish.

C. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's
standard colors. Product shall comply with UL-94 V-0 requirements for self-extinguishing characteristics.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets:
   1. Comply with TIA-569-B.
   2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy aluminum, Type FD, with gasketed cover.

D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

E. Metal Floor Boxes:
   1. Material: Cast metal.
   2. Type: Fully adjustable.
   3. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Nonmetallic Floor Boxes: Nonadjustable, round.
   1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

J. Gangable boxes are prohibited.

K. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Nonmetallic Enclosures: Plastic or fiberglass.
   3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

M. Cabinets:
   1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND CABLING

A. General Requirements for Handholes and Boxes:
   1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
   2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   3. Comply with TIA-568-B.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
   1. Standard: Comply with SCTE 77.
   2. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
   3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
   4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   5. Cover Legend: Molded lettering, "COMMUNICATIONS."

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.
   1. Standard: Comply with SCTE 77.
   2. Color of Frame and Cover: Gray
   3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
   4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
   5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   6. Cover Legend: Molded lettering, "COMMUNICATIONS."

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
   1. Exposed Conduit: RNC, Type EPC-80-PVC.
   2. Concealed Conduit, Aboveground: RNC, Type EPC-40-PVC.
   3. Underground Conduit: RNC, Type EPC-40-PVC.
   4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: ENT.
   2. Exposed, Not Subject to Severe Physical Damage: ENT.
   3. Exposed and Subject to Severe Physical Damage: GRC.
   4. Concealed in Ceilings and Interior Walls and Partitions: ENT.
5. Damp or Wet Locations: GRC.
6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway
7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: [Riser-type, optical-fiber-cable pathway.
8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, communications-cable pathway.
9. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel nonmetallic in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 3/4-inch trade size. Minimum size for optical-fiber cables is 1 inch.

D. Pathway Fittings: Compatible with pathways and suitable for use and location.
1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use setscrew fittings. Comply with NEMA FB 2.10.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for hangers and supports.

D. Arrange stub-ups so curved portions of bends are not visible above finished slab.

E. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Pathways Embedded in Slabs:
1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
3. Arrange pathways to keep a minimum of 1 inch of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
H. Stub-ups to Above Recessed Ceilings:
   1. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

I. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

J. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

K. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

M. Spare Pathways: Install pull wires in empty pathways. Cap underground pathways designated as spare above grade alongside pathways in use.

N. Surface Pathways:
   1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.

O. Pathways for Optical-Fiber and Communications Cable: Install pathways as follows:
   1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
   2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
   3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements.

P. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound.

Q. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where an underground service pathway enters a building or structure.
   3. Where otherwise required by NFPA 70.

R. Expansion-Joint Fittings:
   1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
   2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F.
b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F
c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

S. Mount boxes at heights indicated on Drawings in accordance with ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

T. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 2000 "Earth Moving" for pipe less than 6 inches in nominal diameter.

2. Install backfill as specified in Section 31 2000 "Earth Moving."

3. After installing conduit, backfill and compact. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 2000 "Earth Moving."

4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.

   b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

5. Underground Warning Tape: Comply with requirements in Section 26 0553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDBOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
C. Install handholes with bottom below frost line, below grade.
D. Field cut openings for conduits according to enclosure manufacturer's written instructions.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 27 0544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 8413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.

END OF SECTION 27 0528
SECTION 27 0544
SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
5. Silicone sealants.

B. Related Requirements:

1. Section 07 8413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

2. Minimum Metal Thickness:
a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Advance Products & Systems, Inc.
   b. CALPICO, Inc.
   c. HOLDRITE.
   d. Metraflex Company (The).
   e. Pipeline Seal and Insulator, Inc.
   f. Proco Products, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: [Carbon steel] [Plastic] [Stainless steel].

4. Connecting Bolts and Nuts: [Carbon steel, with corrosion-resistant coating.] [Stainless steel] of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. HOLDRITE.

2.4 GROUT

A. Description: Non-shrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.


C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.
2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
   2. Sealant shall have VOC content of g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 9200 "Joint Sealants."
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide [1/4-inch] <Insert dimension> annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
   5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
   2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 27 0544
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Telecommunications mounting elements.
   2. Backboards.

B. Related Requirements:
   1. Section 270536 "Cable Trays for Communications Systems" for cable trays and accessories.
   2. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
   3. Section 271500 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.
   4. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
   3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer qualified layout technician, installation supervisor, and field inspector.

B. Seismic Qualification Certificates: For equipment frames from manufacturer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, 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 to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Equipment frames shall withstand the effects of earthquake motions determined according to ASCE 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Section 061000 "Rough Carpentry."

2.3 POWER STRIPS

A. Power Strips: Comply with UL 1363.
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Rack mounting.
   4. LED indicator lights for power and protection status.
   5. LED indicator lights for reverse polarity and open outlet ground.
   6. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
   7. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
   9. Rocker-type on-off switch, illuminated when in on position.
   11. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

2.4 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
B. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with J-STD-607-A.

2.5 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for materials and installation requirements for [underground] pathways.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.3 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

   1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for [Class 2] level of administration.

D. Labels shall be preprinted or computer-printed type.
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pathways.
   2. UTP cable.
   3. Cable connecting hardware, patch panels, and cross-connects.

B. Related Sections:
   1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.2 BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:
   1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
   2. Cabling administration drawings and printouts.
   3. Wiring diagrams to show typical wiring schematics including the following:
      b. Patch panels.
      c. Patch cords.
4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
5. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
   
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 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.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.


1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site. Test each pair of UTP cable for open and short circuits.
PART 2 - PRODUCTS

2.1 PATHWAYS

A. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

B. Cable Trays:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following]
   a. Cable Management Solutions, Inc.
   b. Cablofil Inc.
   c. Cooper B-Line, Inc.
   d. Cope - Tyco/Allied Tube & Conduit.
   e. GS Metals Corp.

2. Cable Tray Material: Metal, suitable for indoors, and protected against corrosion by [electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inches (0.012 mm) thick]
   a. Basket Cable Trays: [6 inches (150 mm) wide and 2 inches (50 mm) deep] Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
   b. Trough Cable Trays: [Nominally 6 inches (150 mm)] wide.
   c. Ladder Cable Trays: [Nominally 18 inches (455 mm)] wide, and a rung spacing of [12 inches (305 mm)].
   d. Channel Cable Trays: One-piece construction, [nominally 4 inches (100 mm)] wide. Slot spacing shall not exceed 4-1/2 inches (115 mm) o.c.
   e. Solid-Bottom Cable Trays: One-piece construction, [nominally 12 inches (305 mm)] wide. Provide [with] solid covers.

C. Conduit and Boxes: Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems." [flexible metal conduit shall not be used.]

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.
2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following]:

1. Belden CDT Inc.; Electronics Division.
2. Berk-Tek; a Nexans company.
3. CommScope, Inc.
4. Draka USA.
5. Genesis Cable Products; Honeywell International, Inc.
6. KRONE Incorporated.
7. Mohawk; a division of Belden CDT.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Superior Essex Inc.
10. SYSTIMAX Solutions; a CommScope Inc. brand.
11. 3M.
12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, 100-pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket and overall metallic shield.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, [Category 6].
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

   a. Communications, General Purpose: Type CM or CMG; or MPP, CMP, MPR, CMR, MP, or MPG.
   b. Communications, Plenum Rated: Type CMP or MPP, complying with NFPA 262.
   c. Communications, Riser Rated: Type CMR; or MPP, CMP, or MPR, complying with UL 1666.
   d. Communications, Limited Purpose: Type CMX; or MPP, CMP, MPR, CMR, MP, MPG, CM, or CMG.
   e. Multipurpose: Type MP or MPG; or MPP or MPR.
   f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
   g. Multipurpose, Riser Rated: Type MPR; or MPP, complying with UL 1666.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following]:

2. Dynacom Corporation.
3. Hubbell Premise Wiring.
4. KRONE Incorporated.
5. Leviton Voice & Data Division.
6. Molex Premise Networks; a division of Molex, Inc.
7. Nordex/CDT; a subsidiary of Cable Design Technologies.
8. Panduit Corp.
10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
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 5e** Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
   
   1. Number of Terminals per Field: One for each conductor in assigned cables.

E. 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**.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, 4-pair cables in **36-inch (900-mm)** lengths; terminated with 8-position modular plug at each end.
   
   1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
   2. Patch cords shall have color-coded boots for circuit identification.

2.5 **GROUNDING**

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.6 **IDENTIFICATION PRODUCTS**

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 **SOURCE QUALITY CONTROL**

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Cable will be considered defective if it does not pass tests and inspections.
PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal 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.

3.3 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.

B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

D. Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

F. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits 3 inches (76 mm) above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

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 indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. 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.
8. 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.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. 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 (200 mm) above ceilings by cable supports not more than [60 inches (1524 mm)] apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. 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 (1800 mm)] long not less than [12 inches (300 mm)] in diameter below each feed point.

F. Group connecting hardware for cables into separate logical fields.

G. 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 nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
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 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
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:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."
B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
C. Comply with BICSI TDMM, "Firestopping Systems" Article.
3.6 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Administration Class: [1].
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration including optional identification requirements of this standard.

D. 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.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

F. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. 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.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. 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.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:


2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

C. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

D. Prepare test and inspection reports.

END OF SECTION 271300
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. UTP cabling.
2. Multiuser telecommunications outlet assemblies.
3. Cable connecting hardware, patch panels, and cross-connects.
4. Telecommunications outlet/connectors.
5. Cabling system identification products.

B. Related Requirements:

1. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
2. Wiring diagrams to show typical wiring schematics, including the following:
   b. Patch panels.
   c. Patch cords.
3. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.

2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.

3. Bridged taps and splices shall not be installed in the horizontal cabling.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.
B. Surface-Burning Characteristics: Comply with ASTM E 84; testing 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.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.


2.3 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.

2.4 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.
2. Belden Inc.
3. Berk-Tek; a Nexans company.
4. CommScope, Inc.
5. Draka Cableteq USA.
7. Mohawk; a division of Belden Networking, Inc.
8. Superior Essex Inc.
9. SYSTIMAX Solutions; a CommScope, Inc. brand.
10. 3M Communication Markets Division.
11. Tyco Electronics Corporation; AMP Products.

B. Description: 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

   a. Communications, General Purpose: Type CM or CMG; or MPP, CMP, MPR, CMR, MP, or MPG.
   b. Communications, Plenum Rated: Type CMP or MPP, complying with NFPA 262.
   c. Communications, Riser Rated: Type CMR; or MPP, CMP, or MPR, complying with UL 1666.
   d. Communications, Limited Purpose: Type CMX; or MPP, CMP, MPR, CMR, MP, MPG, CM, or CMG.
   e. Multipurpose: Type MP or MPG; or MPP or MPR.
   f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
2.5 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:

1. ADC.
3. Belden Inc.
4. Dynacom Inc.
5. Hubbell Premise Wiring.
6. Leviton Commercial Networks Division.
7. Molex Premise Networks; a division of Molex, Inc.
8. Panduit Corp.
10. Tyco Electronics Corporation; AMP Products.

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 5e Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: [One] for each conductor in assigned cables.

E. 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.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, four-pair cables in 36-inch (900 mm) 48-inch1200-mm lengths; terminated with eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

2.6 CONSOLIDATION POINTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Belden Inc.
3. Chatsworth Products, Inc.
4. Dynacom Inc.
5. Hubbell Premise Wiring.
6. Molex Premise Networks; a division of Molex, Inc.
7. Ortronics, Inc.; a subsidiary of Legrand Group.
8. Panduit Corp.

B. Description: Consolidation points shall comply with requirements for cable connecting hardware.

1. Number of Terminals per Field: [One] for each conductor in assigned cables.
2. Number of Connectors per Field:
   a. **One** for each four-pair UTP cable indicated.
   b. **One** for each four-pair conductor group of indicated cables, plus [25] percent spare positions.
3. Mounting: **Recessed in ceiling**.
4. NRTL listed as complying with UL 50 and UL 1863.
5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.7 MULTIUSER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following]:

1. Belden Inc.
2. Chatsworth Products, Inc.
3. Hubbell Premise Wiring.
4. Molex Premise Networks; a division of Molex, Inc.
5. Ortronics, Inc.; a subsidiary of Legrand Group.
6. Panduit Corp.
7. Siemon Co. (The).

B. Description: MUTOAs shall meet the requirements for cable connecting hardware.

1. Number of Terminals per Field: [One] for each conductor in assigned cables.
2. Number of Connectors per Field:
   a. **One** for each four-pair UTP cable indicated.
   b. **One** for each four-pair conductor group of indicated cables, plus [25] percent spare positions.
3. Mounting: **Recessed in ceiling**.
4. NRTL listed as complying with UL 50 and UL 1863.
5. Label shall include maximum length of work area cords, based on TIA/EIA-568-B.1.
6. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.
2.8 TELECOMMUNICATIONS OUTLET/CONNECTORS


B. Workstation Outlets: Two-port-connector assemblies mounted in single faceplate.
   1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
   2. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
   3. For use with snap-in jacks accommodating any combination of UTP work area cords.
      a. Flush mounting jacks, positioning the cord at a 45-degree angle.
   4. Legend: Factory labeled by silk-screening or engraving [for].
   5. Legend: Machine printed, in the field, using adhesive-tape label.

2.9 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with J-STD-607-A.

2.10 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.
PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements in Section 270528 "Pathways for Communications Systems."
3. Comply with requirements in Section 270536 "Cable Trays for Communications Systems."

B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. MUTOA shall not be used as a cross-connect point.
5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
   a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
   b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.

6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

9. 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. Install lacing bars and distribution spools.

10. 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.

11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

12. In the communications equipment room, install a 10-foot- (3-m-) 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:


2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. 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 (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. 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 (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B 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 nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

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 2 kVA: A minimum of 2-1/2 inches (64 mm).
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

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:

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Administration Class: [1].
2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for [Class 2] level of administration, including optional identification requirements of this standard.

D. Cable Schedule: Post in 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.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

F. Cable and Wire Identification:
   1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
   2. 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.
   3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
   4. 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 shall be identified with name and number of particular device as shown.
      b. Label each unit and field within distribution racks and frames.
   5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
   6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
   1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
2. Visually confirm [Category 5e,] [Category 6,] marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
5. UTP Performance Tests:
   a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
      1) Wire map.
      2) Length (physical vs. electrical, and length requirements).
      3) Insertion loss.
      4) Near-end crosstalk (NEXT) loss.
      5) Power sum near-end crosstalk (PSNEXT) loss.
      6) Equal-level far-end crosstalk (ELFEXT).
      7) Power sum equal-level far-end crosstalk (PSELFEXT).
      8) Return loss.
      9) Propagation delay.
     10) Delay skew.
6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
   a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
   b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
   B. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
   C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
   D. Prepare test and inspection reports.
3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION 271500
SECTION 28 3111
DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

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. Section Includes:
   1. Fire-alarm control unit.
   3. System smoke detectors.
   5. Firefighters' two-way telephone communication service.
   7. Addressable interface device.
   8. Digital alarm communicator transmitter.

1.3 DEFINITIONS
A. LED: Light-emitting diode.

1.4 SYSTEM DESCRIPTION
A. Non-coded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.
B. Non-coded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 PERFORMANCE REQUIREMENTS
A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.6 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
   2. Include voltage drop calculations for notification appliance circuits.
   3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.

6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.

7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

8. Provide transient protection per NFPA 72 4.4.4.3

C. General Submittal Requirements:
   1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
   2. Shop Drawings shall be prepared by persons with the following qualifications:
      a. Trained and certified by manufacturer in fire-alarm system design.
      b. NICET-certified fire-alarm technician, Level IV minimum.
      c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
   2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," deliver copies to authorities having jurisdiction and include the following:
   1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.

3. Record copy of site-specific software.

4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
   a. Frequency of testing of installed components.
   b. Frequency of inspection of installed components.
   c. Requirements and recommendations related to results of maintenance.
   d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.

6. Abbreviated operating instructions for mounting at fire-alarm control unit.

B. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On magnetic media or compact disk, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
   2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
   3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
   4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
   5. Keys and Tools: One extra set for access to locked and tamperproofed components.
   6. Audible and Visual Notification Appliances: One of each type installed.
   7. Fuses: Two of each type installed in the system.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL.

F. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.
G. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FMG-approved alarm company.

1.11 SOFTWARE SERVICE AGREEMENT
A. Comply with UL 864.
B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
   1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. EST Edwards System Technology
   2. SimplexGrinnell LP; a Tyco International company.

2.2 SYSTEMS OPERATIONAL DESCRIPTION
A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
   2. Heat detectors.
   3. Smoke detectors.
   4. Duct smoke detectors.
   5. Verified automatic alarm operation of smoke detectors.
   6. Automatic sprinkler system water flow.
   7. Heat detectors in elevator shaft and pit.
   8. Fire-extinguishing system operation.
   9. Fire standpipe system.
B. Fire-alarm signal shall initiate the following actions:
   1. Continuously operate alarm notification appliances.
   2. Identify alarm at fire-alarm control unit and remote annunciators.
   3. Transmit an alarm signal to the remote alarm receiving station.
   4. Release fire and smoke doors held open by magnetic door holders.
   5. Activate voice/alarm communication system.
   6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
   7. Activate stairwell and elevator-shaft pressurization systems.
   8. Close smoke dampers in air ducts of designated air-conditioning duct systems.
   9. Recall elevators to primary or alternate recall floors.
  10. Activate emergency lighting control.
  11. Activate emergency shutoffs for gas and fuel supplies.
  12. Record events in the system memory.
C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.
3. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Low-air-pressure switch operation on a dry-pipe or pre-action sprinkler system.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
   a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
   b. Include a real-time clock for time annotation of events on the event recorder and printer.
2. Addressable initiation devices that communicate device identity and status.
   a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
   b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 3 line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:
1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
   a. Initiating Device Circuits: Style B.
   b. Notification Appliance Circuits: Style Y.
   d. Install no more than 50 addressable devices on each signaling line circuit.
D. Elevator Recall:
   1. Smoke detectors at the following locations shall initiate automatic elevator recall.
      a. Elevator lobby detectors except the lobby detector on the designated floor.
      b. Smoke detector in elevator machine room.
      c. Smoke or Heat detectors in elevator hoistway.
   2. Elevator lobby detectors located on the designated recall floors shall be programmed to
      move the cars to the alternate recall floor.
   3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room
      shall shut down elevators associated with the location without time delay.
      a. Water-flow switch associated with the sprinkler in the elevator pit may have a
data delay to allow elevators to move to the designated floor.

E. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in
smoke barrier walls shall be connected to fire-alarm system.

F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable
smoke detectors for adjustment, display their current status and sensitivity settings, and change
those settings. Allow controls to be used to program repetitive, time-scheduled, and automated
changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-
adjustment schedule changes in system memory, and print out the final adjusted values on
system printer.

G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory,
and trouble signals to a remote alarm station.

H. Voice/Alarm Signaling Service: Central emergency communication system with redundant
microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is
part of fire-alarm control unit.
   1. Indicated number of alarm channels for automatic, simultaneous transmission of different
      announcements to different zones or for manual transmission of announcements by use
      of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by
      an NRTL.
      a. Allow the application of and evacuation signal to indicated number of zones and,
at same time, allow voice paging to the other zones selectively or in any
      combination.
      b. Programmable tone and message sequence selection.
      c. Standard digitally recorded messages for "Evacuation" and "All Clear."
      d. Generate tones to be sequenced with audio messages of type recommended by
         NFPA 72 and that are compatible with tone patterns of notification appliance
circuits of fire-alarm control unit.
   2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the
      status of firefighters’ two-way telephone communication zones.
   3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units,
on primary equipment failure.

I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating
devices, notification appliances, signaling lines, trouble signals, supervisory signals supervisory
and digital alarm communicator transmitters and digital alarm radio transmitters shall be
powered by 24-V dc source.
   1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-
      supply module rating.

J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and
automatic transfer switch.

K. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer’s surface back box.
   1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
   2. Station Reset: Key- or wrench-operated switch.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:
   1. Comply with UL 268; operating at 24-V dc, nominal.
   2. Detectors shall be two-wire type.
   3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
   4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
   5. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
   6. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
      a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
      b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
      c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:
   1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
   2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
      a. Primary status.
      b. Device type.
      c. Present average value.
      d. Present sensitivity selected.
      e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
   1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
   2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
      a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

2.6 HEAT DETECTORS
A. General Requirements for Heat Detectors: Comply with UL 521.
B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
   1. Mounting: Adapter plate for outlet box mounting.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
   1. Mounting: Adapter plate for outlet box mounting.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
D. Continuous Linear Heat-Detector System:
   1. Detector Cable: Rated detection temperature 155 deg F. NRTL listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short-circuit wires at the location of elevated temperature.
   2. Control Unit: Two-zone or multi-zone unit as indicated. Provide same system power supply, supervision, and alarm features as specified for fire-alarm control unit.
   3. Signals to Fire-Alarm Control Unit: Any type of local system trouble shall be reported to fire-alarm control unit as a composite "trouble" signal. Alarms on each detection zone shall be individually reported to central fire-alarm control unit as separately identified zones.
   4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES
A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.
B. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
   1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

E. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

F. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch high letters on the lens.
   1. Rated Light Output:
      a. 15/30/75/110 cd, selectable in the field.
   2. Mounting: Wall mounted unless otherwise indicated.
   3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
   4. Flashing shall be in a temporal pattern, synchronized with other units.
   5. Strobe Leads: Factory connected to screw terminals.

G. Voice/Tone Notification Appliances:
   1. Combination voice/evacuation and notification devices are preferred.
   2. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
   3. High-Range Units: Rated 2 to 15 W.
   4. Low-Range Units: Rated 1 to 2 W.
   6. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.8 VOICE EVACUATION

A. Voice evacuation shall be included everywhere and shall comply with the guidelines of IEC 60849-1998 to achieve an intelligibility value equivalent to a Common Intelligibility Scale (CIS) of 0.70 or greater. Drawings show general layout and spacing, however it is the contractors responsibility to provide a layout that meets all applicable codes and requirements listed.

B. All speaker circuits shall be field selectable for 25 or 70 Vrms operation and shall be power limited.

C. The voice evacuation system shall be microprocessor based, and shall contain an integral microphone, 25 Watt audio amplifier, tone generator, digital message repeater, 120 VAC power supply, and battery charger.

D. The voice evacuation message/signal shall be broadcast until the Fire Alarm Control Panel (FACP) is reset, or until fire emergency personnel interrupt the broadcast with a manual page. On reset system shall automatically return to standby (normal operating) condition.

E. A secondary message shall be provided that can be triggered by the closure of a contact from either the FACP or from any normally open contact device.

F. Remote paging microphone(s) will be supported by the system through a supervised circuit. Remote microphone(s) may be mounted up to 5,000 ft. (1,524 m) away from the voice evacuation panel.
2.9 MAGNETIC DOOR HOLDERS
A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
   1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
   2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
   3. Rating: 24-V ac or dc.
   4. Rating: 120-V ac.
B. Material and Finish: Match door hardware.

2.10 REMOTE ANNUNCIATOR
A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
   1. Mounting: Flush cabinet, NEMA 250, Type 1.
B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.11 ADDRESSABLE INTERFACE DEVICE
A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER
A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
C. Local functions and display at the digital alarm communicator transmitter shall include the following:
   1. Verification that both telephone lines are available.
   2. Programming device.
   3. LED display.
   5. Communications failure with the central station or fire-alarm control unit.
D. Digital data transmission shall include the following:
1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

E. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
   1. Comply with requirements for seismic-restraint devices specified in Section 26 0548 "Vibration and Seismic Controls for Electrical Systems."

C. Smoke- or Heat-Detector Spacing:
   3. Smooth ceiling spacing shall not exceed 30 feet.
   4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
   5. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
   6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

E. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

F. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

G. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

H. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.

J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

K. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.

L. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.2 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 08 7100 "Door Hardware." Connect hardware and devices to fire-alarm system.
   1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
   2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
   3. Smoke dampers in air ducts of designated air-conditioning duct systems.
   4. Alarm-initiating connection to elevator recall system and components.
   5. Alarm-initiating connection to activate emergency lighting control.
   6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
   7. Supervisory connections at valve supervisory switches.
   8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
  10. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
  11. Supervisory connections at fire-pump engine control panel.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction and a MSU representative.
B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:
   1. Visual Inspection: Conduct visual inspection prior to testing.
      a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
      b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
   3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
   4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
   5. Test visible appliances for the public operating mode according to manufacturer's written instructions.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.6 DEMONSTRATION
   A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.
SECTION 31 1000
SITE CLEARING

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Clearing and protection of vegetation.
   B. Removal of existing debris.

1.02 RELATED REQUIREMENTS
   A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.
   B. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
   C. Section 01 5713 - Temporary Erosion and Sediment Control.
   D. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.
   E. Section 01 7419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
   F. Section 02 4100 - Demolition: Removal of built elements and utilities.
   G. Section 31 2200 - Grading: Topsoil removal.
   H. Section 31 2323 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.
   I. Section 32 9300 - Plants: Relocation of existing trees, shrubs, and other plants.

1.03 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Site Plan: Showing:
      1. Areas for temporary construction and field offices.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION
3.01 SITE CLEARING
   A. Comply with other requirements specified in Section 01 7000.
   B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.02 EXISTING UTILITIES AND BUILT ELEMENTS
   A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
   B. Protect existing utilities to remain from damage.
   C. Do not disrupt public utilities without permit from authority having jurisdiction.
   D. Protect existing structures and other elements that are not to be removed.

3.03 VEGETATION
   A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, and planting beds.
   B. Do not begin clearing until vegetation to be relocated has been removed.
   C. Do not remove or damage vegetation beyond the limits indicated on drawings.
      1. 20 feet outside the building perimeter.
      2. 10 feet each side of surface walkways, patios, surface parking, and utility lines less than 12 inches in diameter.
3. 15 feet each side of roadway curbs and main utility trenches.
4. 25 feet outside perimeter of pervious paving areas that must not be compacted by construction traffic.

D. Install substantial, highly visible fences at least 3 feet high to prevent inadvertent damage to vegetation to remain:
   1. At vegetation removal limits.
   2. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
   3. Around other vegetation to remain within vegetation removal limits.
   4. See Section 01 5000 for fence construction requirements.

E. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.

F. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
   1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
   2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.
   3. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.

G. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.04 DEBRIS
   A. Remove debris, junk, and trash from site.
   B. Leave site in clean condition, ready for subsequent work.
   C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION
SECTION 31 2200
GRADING

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Removal of topsoil.
   B. Rough grading the site for building pads and roadways.
   C. Finish grading.

1.02 RELATED REQUIREMENTS
   A. Section 31 1000 - Site Clearing.
   B. Section 31 2316 - Excavation.
   C. Section 31 2316.13 - Trenching: Trenching and backfilling for utilities.
   D. Section 31 2323 - Fill: Filling and compaction.
   E. Section 32 9219 - Seeding: Finish ground cover.

1.03 PRICE AND PAYMENT PROCEDURES
   A. Topsoil:
      1. Measurement Method: By the square yard down to a drawing-defined elevation.
      2. Includes: Excavating existing topsoil, stockpiling, scarifying substrate surface, placing where required, and compacting.

1.04 SUBMITTALS
   A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.05 QUALITY ASSURANCE
   A. Perform Work in accordance with State of Montana, Highway Department standards.

PART 2 PRODUCTS
2.01 MATERIALS
   A. Topsoil: See Section 31 2323.
   B. Other Fill Materials: See Section 31 2323.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.02 PREPARATION
   A. Identify required lines, levels, contours, and datum.
   B. Stake and flag locations of known utilities.
   C. Locate, identify, and protect from damage above- and below-grade utilities to remain.
   D. Notify utility company to remove and relocate utilities.
   E. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, paving, and curbs, from damage by grading equipment and vehicular traffic.
   F. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.
   G. Protect plants and other features to remain as a portion of final landscaping.

3.03 ROUGH GRADING
   A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
B. Do not remove topsoil when wet.
C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
E. When excavating through roots, perform work by hand and cut roots with sharp axe.
F. See Section 31 2323 for filling procedures.
G. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.
H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

3.04 SOIL REMOVAL AND STOCKPILING
A. Stockpile topsoil to be re-used on site; remove remainder from site.
B. Stockpile subsoil to be re-used on site; remove remainder from site.
C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet; protect from erosion.

3.05 FINISH GRADING
A. Before Finish Grading:
   1. Verify building and trench backfilling have been inspected.
   2. Verify subgrade has been contoured and compacted.
B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products.
C. Where topsoil is to be placed, scarify surface to depth of 3 inches.
D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches.
E. Place topsoil in areas where seeding are indicated.
F. Place topsoil where required to level finish grade.
G. Place topsoil to the following compacted thicknesses:
   1. Areas to be Seeded with Grass: 6 inches.
   2. Areas to be Sodded: 4 inches.
H. Place topsoil during dry weather.
I. Remove roots, weeds, rocks, and foreign material while spreading.
J. Near plants spread topsoil manually to prevent damage.
K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
L. Lightly compact placed topsoil.

3.06 TOLERANCES
A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16 inches) from required elevation.
B. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2 inch).

3.07 REPAIR AND RESTORATION
A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.
B. Trees to Remain: If damaged due to this work, trim broken branches and repair bark wounds; if root damage has occurred, obtain instructions from Architect as to remedy.
C. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.08 FIELD QUALITY CONTROL
A. See Section 31 2323 for compaction density testing.
3.09 CLEANING
   A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
   B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION
SECTION 31 2316
EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Excavating for building volume below grade, footings, slabs-on-grade, paving, and utilities within the building.
B. Trenching for utilities outside the building to utility main connections.

1.02 RELATED REQUIREMENTS
A. Section 01 5713 - Temporary Erosion and Sedimentation Control:  Slope protection and erosion control.
B. Section 01 7000 - Execution and Closeout Requirements:  General requirements for dewatering of excavations and water control.
C. Section 02 4100 - Demolition: Shoring and underpinning.
D. Section 31 2200 - Grading:  Soil removal from surface of site.
E. Section 31 2200 - Grading:  Grading.
F. Section 31 2316.13 - Trenching:  Excavating for utility trenches outside the building to utility main connections.
G. Section 31 2323 - Fill:  Fill materials, filling, and compacting.

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Field Quality Control Submittals:  Document visual inspection of load-bearing excavated surfaces.

1.04 PRICE AND PAYMENT PROCEDURES
A. Excavating Soil Materials:
   1. Measurement method:  By the cubic yard.
   2. Includes:  Excavating to required elevations, loading and placing materials in stockpile.
   3. Does Not Include Over-Excavation:  Payment will not be made for over-excavated work nor for replacement materials.
B. See Section 31 2323 - Fill, for measurement and payment provisions related to fill.

1.05 PROJECT CONDITIONS
A. Verify that survey bench mark and intended elevations for the Work are as indicated.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that survey bench mark and intended elevations for the work are as indicated.

3.02 PREPARATION
A. Identify required lines, levels, contours, and datum locations.
B. See Section 31 2200 for additional requirements.

3.03 EXCAVATING
A. Underpin adjacent structures that could be damaged by excavating work.
B. Excavate to accommodate new structures and construction operations.
C. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
D. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
E. Do not interfere with 45 degree bearing splay of foundations.
F. Cut utility trenches wide enough to allow inspection of installed utilities.
G. Hand trim excavations. Remove loose matter.
H. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 2323.
I. Grade top perimeter of excavation to prevent surface water from draining into excavation.
J. Remove excavated material that is unsuitable for re-use from site.
K. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 2200.
L. Remove excess excavated material from site.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
B. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.

3.05 PROTECTION

A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Backfilling and compacting for utilities outside the building to utility main connections.

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading: Site grading.

1.03 PRICE AND PAYMENT PROCEDURES

A. Excavating Soil Materials:
   1. Measurement method: By the cubic yard.
   2. Includes: Excavating to required elevations, loading and placing materials in stockpile.
   3. Does Not Include Over-Excavation: Payment will not be made for over-excavated work nor for replacement materials.

B. General Fill:
   1. Measurement Method: By the square yard down to a drawing-defined elevation.
   2. Includes: Excavating existing soil, stockpiling, scarifying substrate surface, placing where required, and compacting.

C. Structural Fill:
   1. Measurement Method: By the square yard down to a drawing-defined elevation.
   2. Includes: Excavating existing soil, stockpiling, scarifying substrate surface, placing where required, and compacting.

D. Granular Fill:
   1. Measurement Method: By the square yard down to a drawing-defined elevation.
   2. Includes: Excavating existing material, stockpiling, scarifying substrate surface, placing where required, and compacting.

1.04 DEFINITIONS

A. Subgrade Elevations: 4 inches below finish grade elevations indicated on drawings, unless otherwise indicated.

B. Finish Grade Elevations: 4 inches above subgrade elevations indicated on drawings, unless otherwise indicated.

1.05 REFERENCES


B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.


D. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.


F. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Samples: 10 lb sample of each type of fill; submit in air-tight containers to testing laboratory.

C. Materials Sources: Submit name of imported materials source.
D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
E. Compaction Density Test Reports.

1.07 DELIVERY, STORAGE, AND HANDLING
A. When necessary, store materials on site in advance of need.
B. When fill materials need to be stored on site, locate stockpiles where indicated.
   1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
   2. Prevent contamination.
   3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS
2.01 FILL MATERIALS
A. General Fill: Conforming to State of Montana Highway Department standard.
B. Structural Fill: Conforming to State of Montana Highway Department standard.
C. Granular Fill: Coarse aggregate, conforming to State of Montana Highway Department standard.
D. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.
   1. Graded in accordance with ASTM C136/C136M; within the following limits:
      a. No. 4 sieve: 100 percent passing.
      b. No. 14 sieve: 10 to 100 percent passing.
      c. No. 50 sieve: 5 to 90 percent passing.
      d. No. 100 sieve: 4 to 30 percent passing.
      e. No. 200 sieve: 0 percent passing.
E. Topsoil: See Section 31 2200.

2.02 ACCESSORIES
A. Geotextile Fabric: Non-biodegradable, woven.

2.03 SOURCE QUALITY CONTROL
A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of soil material.
B. Where fill materials are specified by reference to a specific standard, testing of samples for compliance will be provided before delivery to site.
C. If tests indicate materials do not meet specified requirements, change material and retest.
D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.02 PREPARATION
A. Identify required lines, levels, contours, and datum locations.
B. See Section 31 2200 for additional requirements.

3.03 TRENCHING
A. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
C. Do not interfere with 45 degree bearing splay of foundations.
D. Cut trenches wide enough to allow inspection of installed utilities.
E. Hand trim excavations. Remove loose matter.
F. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
G. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.
H. Remove excavated material that is unsuitable for re-use from site.
I. Stockpile excavated material to be re-used in area designated in Section 31 2200.
J. Remove excess excavated material from site.

3.04 PREPARATION FOR UTILITY PLACEMENT
A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.05 BACKFILLING
A. Backfill to contours and elevations indicated using unfrozen materials.
B. Employ a placement method that does not disturb or damage other work.
C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
D. Maintain optimum moisture content of fill materials to attain required compaction density.
E. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.
F. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.
G. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
H. Correct areas that are over-excavated.
   1. Thrust bearing surfaces: Fill with concrete.
   2. Other areas: Use structural fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
I. Compaction Density Unless Otherwise Specified or Indicated:
   1. Under paving, slabs-on-grade, and similar construction: 97 percent of maximum dry density.
   2. At other locations: 95 percent of maximum dry density.
J. Reshape and re-compact fills subjected to vehicular traffic.

3.06 BEDDING AND FILL AT SPECIFIC LOCATIONS
A. Use general fill unless otherwise specified or indicated.
B. Utility Piping, Conduits, and Duct Bank:
   2. Cover with general fill.
   3. Fill up to subgrade elevation.
   4. Compact in maximum 8 inch lifts to 95 percent of maximum dry density.
C. Over Subdrainage Piping at Foundation Perimeter and Under Slabs:
   1. Drainage fill and geotextile fabric: Section 33 4600.
   2. Cover drainage fill with general fill.
   3. Fill up to subgrade elevation.
   4. Compact to 95 percent of maximum dry density.
D. At French Drains:
   1. Use granular fill.
2. Fill up to 8 inches below finish grade.
3. Compact to 95 percent of maximum dry density.

3.07 TOLERANCES
A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.
B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.08 FIELD QUALITY CONTROL
A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D3017, or ASTM D6938.
C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor") or ASTM D1557 ("modified Proctor").
D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

3.09 CLEANING
A. Leave unused materials in a neat, compact stockpile.
B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Filling, backfilling, and compacting for building volume below grade.
B. Backfilling and compacting for utilities outside the building to utility main connections.
C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading: Removal and handling of soil to be re-used.
B. Section 31 2200 - Grading: Site grading.
C. Section 31 2316 - Excavation: Removal and handling of soil to be re-used.
D. Section 31 2316.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.

1.03 PRICE AND PAYMENT PROCEDURES

A. General Fill:
   1. Measurement Method: By the square yard down to a drawing-defined elevation.
   2. Includes: Excavating existing soil, stockpiling, scarifying substrate surface, placing where required, and compacting.
B. Structural Fill:
   1. Measurement Method: By the square yard down to a drawing-defined elevation.
   2. Includes: Excavating existing soil, stockpiling, scarifying substrate surface, placing where required, and compacting.
C. Granular Fill:
   1. Measurement Method: By the square yard down to a drawing-defined elevation.
   2. Includes: Excavating existing material, stockpiling, scarifying substrate surface, placing where required, and compacting.

1.04 DEFINITIONS

A. Subgrade Elevations: 4 inches below finish grade elevations indicated on drawings, unless otherwise indicated.
B. Finish Grade Elevations: 4 inches above subgrade elevations indicated on drawings, unless otherwise indicated.

1.05 REFERENCE STANDARDS

A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010
C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012.
D. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Samples: 10 lb sample of each type of fill; submit in air-tight containers to testing laboratory.
C. Materials Sources: Submit name of imported materials source.
D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
E. Compaction Density Test Reports.

1.07 DELIVERY, STORAGE, AND HANDLING
A. When necessary, store materials on site in advance of need.
B. When fill materials need to be stored on site, locate stockpiles where indicated.
   1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
   2. Prevent contamination.
   3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS
2.01 FILL MATERIALS
A. General Fill: Conforming to State of Montana Highway Department standard.
B. Structural Fill: Conforming to State of Montana Highway Department standard.
C. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.
   1. Graded in accordance with ASTM C136/C136M; within the following limits:
      a. No. 4 sieve: 100 percent passing.
      b. No. 14 sieve: 10 to 100 percent passing.
      c. No. 50 sieve: 5 to 90 percent passing.
      d. No. 100 sieve: 4 to 30 percent passing.
      e. No. 200 sieve: 0 percent passing.
D. Topsoil: See Section 31 2200.

2.02 ACCESSORIES
A. Geotextile Fabric: Non-biodegradable, woven.

2.03 SOURCE QUALITY CONTROL
A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of soil material.
B. Where fill materials are specified by reference to a specific standard, testing of samples for compliance will be provided before delivery to site.
C. If tests indicate materials do not meet specified requirements, change material and retest.
D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that survey bench marks and intended elevations for the Work are as indicated.
B. Identify required lines, levels, contours, and datum locations.
C. See Section 31 2200 for additional requirements.
D. Verify subdrainage, damp proofing, or waterproofing installation has been inspected.
E. Verify structural ability of unsupported walls to support imposed loads by the fill.
F. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.

3.02 PREPARATION
A. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots.
B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.
3.03 FILLING
A. Fill to contours and elevations indicated using unfrozen materials.
B. Fill up to subgrade elevations unless otherwise indicated.
C. Employ a placement method that does not disturb or damage other work.
D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
E. Maintain optimum moisture content of fill materials to attain required compaction density.
F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.
G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.
H. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
I. Correct areas that are over-excavated.
   1. Load-bearing foundation surfaces: Use structural fill, flush to required elevation, compacted to 100 percent of maximum dry density.
   2. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
J. Compaction Density Unless Otherwise Specified or Indicated:
   1. Under paving, slabs-on-grade, and similar construction: 97 percent of maximum dry density.
   2. At other locations: 95 percent of maximum dry density.
K. Reshape and re-compact fills subjected to vehicular traffic.

3.04 FILL AT SPECIFIC LOCATIONS
A. Use general fill unless otherwise specified or indicated.
B. Structural Fill:
   1. Use structural fill.
   2. Maximum depth per lift: 6 inches, compacted.
   3. Compact to minimum 95 percent of maximum dry density.
C. Under Interior Slabs-On-Grade:
   1. Use granular fill.
   2. Compact to 95 percent of maximum dry density.
D. At Foundation Walls and Footings:
   1. Use general fill.
   2. Fill up to subgrade elevation.
   3. Compact each lift to 90 percent of maximum dry density.
   4. Do not backfill against unsupported foundation walls.
   5. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.
E. Over Subdrainage Piping at Foundation Perimeter and Under Slabs:
   1. Drainage fill and geotextile fabric: Section 33 4600.
   2. Cover drainage fill with general fill.
   3. Compact to 95 percent of maximum dry density.
F. Over Buried Utility Piping, Conduits, and Duct Bank in Trenches:
   2. Cover with general fill.
   3. Fill up to subgrade elevation.
   4. Compact in maximum 8 inch lifts to 95 percent of maximum dry density.
G. At Lawn Areas:
   1. Use general fill.
   2. Fill up to subgrade elevations.
   3. Compact to 95 percent of maximum dry density.
   4. See Section 31 2200 for topsoil placement.

H. At Planting Areas Other Than Lawns:
   1. Use general fill.
   2. Fill up to subgrade elevations.
   3. Compact to 95 percent of maximum dry density.
   4. See Section 31 2200 for topsoil placement.

I. At French Drains:
   1. Use granular fill.
   2. Fill up to 8 inches below finish grade.
   3. Compact to 95 percent of maximum dry density.

3.05 TOLERANCES
A. Top Surface of General Filling: Plus or minus 1 inch from required elevations.
B. Top Surface of Filling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.06 FIELD QUALITY CONTROL
A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
B. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor"), ASTM D1557 ("modified Proctor"), or AASHTO T 180.
C. If tests indicate work does not meet specified requirements, remove work, replace and retest.
D. Proof roll compacted fill at surfaces that will be under slabs-on-grade.

3.07 CLEANING
A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION
SECTION 32 1216
ASPHALT PAVING

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Aggregate base course.
   B. Double course bituminous concrete paving.
   C. Surface sealer.

1.02 RELATED REQUIREMENTS
   A. Section 31 2200 - Grading: Preparation of site for paving and base.
   B. Section 31 2323 - Fill: Compacted subgrade for paving.
   C. Section 32 1313 - Concrete Paving: Concrete curbs.

1.03 PRICE AND PAYMENT PROCEDURES
   A. See Section 01 2200 - Unit Prices for requirements applicable to this section. Measurement and payment will be as follows:
      B. Asphalt Pavement Mix (Base Course): By the ton. Includes preparing base, tack coating surfaces, placing, compacting and rolling, testing. Includes mix design, supplying to site, testing.
      C. Asphalt Pavement Mix (Binder Course): By the ton. Includes preparing base, tack coating surfaces, placing, compacting and rolling, testing. Includes mix design, supplying to site, testing.
      D. Asphalt Pavement Mix (Wearing Course): By the ton. Includes preparing base, tack coating surfaces, placing, compacting and rolling, testing. Includes mix design, supplying to site, testing.
      E. Seal Coat: By the square yard. Includes preparing surfaces and applying.

1.04 REFERENCE STANDARDS
   A. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types; The Asphalt Institute; 1997.

1.05 PERFORMANCE REQUIREMENTS
   A. Design paving and subbase at for movement of trucks up to 60,000 lbs.

1.06 QUALITY ASSURANCE
   A. Perform Work in accordance with State of Montana Highways standard.
   B. Mixing Plant: Conform to State of Montana Highways standard.
   C. Obtain materials from same source throughout.

1.07 REGULATORY REQUIREMENTS
   A. Conform to applicable code for paving work on public property.

1.08 FIELD CONDITIONS
   A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.
   B. Place bitumen mixture when temperature is not more than 15 F degrees below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 PRODUCTS
2.01 MATERIALS
   A. Aggregate for Base Course: In accordance with State of Montana Highways standards.
B. Aggregate for Binder Course: In accordance with State of Montana Highways standards.
C. Aggregate for Wearing Course: In accordance with State of Montana Highways standards.
D. Fine Aggregate: In accordance with State of Montana Highways standards.
E. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.
F. Primer: In accordance with State of Montana Highways standards.
G. Tack Coat: Homogeneous, medium curing, liquid asphalt.
H. Seal Coat: AI MS-19, slurry type.

2.02 ASPHALT PAVING MIXES AND MIX DESIGN
A. Base Course: State of Montana Highways standards.
B. Binder Course: State of Montana Highways standards.
C. Wearing Course: State of Montana Highways standards.
D. Submit proposed mix design of each class of mix for review prior to beginning of work.

2.03 SOURCE QUALITY CONTROL
A. Test mix design and samples in accordance with AI MS-2.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.
B. Verify gradients and elevations of base are correct.

3.02 BASE COURSE
A. Place and compact base course.

3.03 PREPARATION - PRIMER
A. Apply primer in accordance with manufacturer's instructions.
B. Apply primer on aggregate base or subbase at uniform rate of 1/3 gal/sq yd.
C. Apply primer to contact surfaces of curbs, gutters.
D. Use clean sand to blot excess primer.

3.04 PREPARATION - TACK COAT
A. Apply tack coat in accordance with manufacturer's instructions.
B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 1/3 gal/sq yd.
C. Coat surfaces of manhole frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.05 PLACING ASPHALT PAVEMENT - DOUBLE COURSE
A. Place asphalt binder course within 24 hours of applying primer or tack coat.
B. Place wearing course within two hours of placing and compacting binder course.
C. Install gutter drainage grilles and frames and manhole frames in correct position and elevation.
D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
E. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.06 SEAL COAT
A. Apply seal coat to surface course in accordance with AI MS-19.
3.07 TOLERANCES
   A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
   B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.
   C. Variation from True Elevation: Within 1/2 inch.

3.08 FIELD QUALITY CONTROL
   A. See Section 01 4000 - Quality Requirements, for general requirements for quality control.
   B. Provide field inspection and testing. Take samples and perform tests in accordance with AI MS-2.

3.09 PROTECTION
   A. Immediately after placement, protect pavement from mechanical injury for two days or until surface temperature is less than 140 degrees F.

END OF SECTION
SECTION 32 1313
CONCRETE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Concrete sidewalks, integral curbs, gutters, and roads.

1.02 RELATED REQUIREMENTS
A. Section 03 3000 - Cast-in-Place Concrete.
B. Section 07 9200 - Joint Sealants: Sealing joints.
C. Section 09 9113 - Exterior Painting: Pavement markings.
D. Section 31 2200 - Grading: Preparation of site for paving and base and preparation of subsoil at pavement perimeter for planting.
E. Section 31 2323 - Fill: Compacted subbase for paving.

1.03 PRICE AND PAYMENT PROCEDURES
A. Concrete paving is to be provided by the unit price method.
B. See Section 01 2200 - Unit Prices, for additional unit price requirements.
C. Concrete Pavement Mix (Base): Measurement by the cubic yard. Includes mix design, supplying to site, testing.
D. Concrete Pavement Mix (Wearing Course): Measurement by the cubic yard. Includes mix design, supplying to site, testing.
E. Concrete Placed: Measurement by the square yard per inch thickness. Includes preparing base, placing, floating and finishing, testing.

1.04 REFERENCE STANDARDS
A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2009).
B. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010 (Errata 2012).
C. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.
D. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.
1.05 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on joint filler, admixtures, and curing compound.
   C. Samples: Submit two sample panels, 12 by 12 inch in size illustrating exposed aggregate finish.
   D. Design Data: Indicate pavement thickness, designed concrete strength, reinforcement, and
typical details.

PART 2 PRODUCTS
2.01 PAVING ASSEMBLIES
   A. Comply with applicable requirements of ACI 301.
   B. Design paving for movement of trucks up to 60,000 lbs.
   C. Parking Area Pavement: 4,000 psi 28 day concrete, 5 inches thick, 6 by 6 - W2.9 by W2.9
   mesh reinforcement, wood float finish.

2.02 FORM MATERIALS
   A. Form Materials: Conform to ACI 301.
   B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D1751) or sponge rubber or cork
   (ASTM D1752).
      1. Thickness: 1/2 inch.

2.03 REINFORCEMENT
   A. Reinforcing Steel: ASTM A615/A615M, Grade 80 (80,000 psi) yield strength; deformed billet
   steel bars; unfinished.
   B. Steel Welded Wire Reinforcement: Plain type, ASTM A1064/A1064M; in flat sheets; unfinished.
   C. Dowels: ASTM A615/A615M, Grade 75 - 75,000 psi yield strength; deformed billet steel bars;
   unfinished finish.

2.04 CONCRETE MATERIALS
   A. Obtain cementitious materials from same source throughout.
   B. Concrete Materials: Provide in accordance with State of Montana Highways standards.

2.05 ACCESSORIES
   A. Curing Compound: ASTM C309, Type 1, Class A.

2.06 CONCRETE MIX DESIGN
   A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
   B. Concrete Strength: Establish required average strength for each type of concrete on the basis
   of field experience or trial mixtures, as specified in ACI 301.
      1. For trial mixtures method, employ independent testing agency acceptable to Architect for
   preparing and reporting proposed mix designs.
   C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates
   recommended by manufacturer.
   D. Concrete Properties:
      1. Compressive strength, when tested in accordance with ASTM C39/C39M at 28 days; 4,000 psi.
      2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
      3. Calcined Pozzolan Content: Maximum 10 percent of cementitious materials by weight.
      4. Silica Fume Content: Maximum 5 percent of cementitious materials by weight.
      5. Water-Cement Ratio: Maximum 40 percent by weight.
      6. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M.
      7. Maximum Slump: 3 inches.
2.07   MIXING
   A. Transit Mixers: Comply with ASTM C94/C94M.

PART 3  EXECUTION

3.01  EXAMINATION
   A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
   B. Verify gradients and elevations of base are correct.

3.02  SUBBASE
   A. Prepare subbase in accordance with State of Montana Highways standards.

3.03  PREPARATION
   A. Moisten base to minimize absorption of water from fresh concrete.
   B. Coat surfaces of manhole frames with oil to prevent bond with concrete pavement.
   C. Notify Architect minimum 24 hours prior to commencement of concreting operations.

3.04  FORMING
   A. Place and secure forms to correct location, dimension, profile, and gradient.
   B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
   C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.05  REINFORCEMENT
   A. Place reinforcement as indicated.
   B. Interrupt reinforcement at contraction joints.
   C. Place dowels to achieve pavement and curb alignment as detailed.
   D. Provide doweled joints 24 inch on center at with one end of dowel set in capped sleeve to allow longitudinal movement.

3.06  COLD AND HOT WEATHER CONCRETING
   A. Follow recommendations of ACI 305R when concreting during hot weather.
   B. Follow recommendations of ACI 306R when concreting during cold weather.
   C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

3.07  PLACING CONCRETE
   A. Place concrete in accordance with State of Montana Highways standards.
   B. Do not place concrete when base surface is wet.
   C. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.
   D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
   E. Apply surface retarder to all exposed surfaces in accordance with manufacturer's instructions.

3.08  JOINTS
   A. Align curb, gutter, and sidewalk joints.
   B. Place 3/8 inch wide expansion joints at 20 foot intervals and to separate paving from vertical surfaces and other components and in pattern indicated.
      1. Form joints with joint filler extending from bottom of pavement to within 1/2 inch of finished surface.
      2. Secure to resist movement by wet concrete.
   C. Provide scored joints.
1. Between sidewalks and curbs.
2. Between curbs and pavement.
D. Provide keyed joints as indicated.
E. Saw cut contraction joints 3/16 inch wide at an optimum time after finishing. Cut 1/3 into depth of slab.

3.09 FINISHING
A. Area Paving: Light broom, texture perpendicular to pavement direction.
B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch radius.
C. Curbs and Gutters: Light broom, texture parallel to pavement direction.
D. Inclined Vehicular Ramps: Broomed perpendicular to slope.
E. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer’s instructions.

3.10 TOLERANCES
A. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.
B. Maximum Variation From True Position: 1/4 inch.

3.11 FIELD QUALITY CONTROL
A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
   1. Provide free access to concrete operations at project site and cooperate with appointed firm.
   2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
   3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
B. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd or less of each class of concrete placed.
   1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.12 PROTECTION
A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
B. Do not permit pedestrian traffic over pavement for 4 days minimum after finishing.

END OF SECTION
SECTION 32 9219
SEEDING

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Placing topsoil.
   B. Seeding, mulching and fertilizer.
   C. Maintenance.

1.02 RELATED REQUIREMENTS
   A. Section 31 2200 - Grading: Topsoil material.
   B. Section 31 2200 - Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this section.
   C. Section 31 2323 - Fill: Topsoil material.

1.03 PRICE AND PAYMENT PROCEDURES
   A. Grassed Areas:
      1. Basis of Measurement: By the square yard.
      2. Basis of Payment: Includes preparation of subsoil, placing topsoil, seeding, watering and maintenance to specified time limit.

1.04 DEFINITIONS

1.05 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.06 REGULATORY REQUIREMENTS
   A. Comply with regulatory agencies for fertilizer and herbicide composition.
   B. Provide certificate of compliance from authority having jurisdiction indicating approval of seed mixture.
   C. All weed control chemicals must be registered with the Environmental Protection Agency and the State of Montana.
   D. The Contractor shall have at least two (2) years of weed control spraying experience. Proof of experience will be required. The Contractor must have a valid Montana Commercial Herbicide Applicator's License.

1.07 DELIVERY, STORAGE, AND HANDLING
   A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.
   B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2 PRODUCTS
2.01 SEED MIXTURE
   A. Irrigated Seed Mixture:
      1. 'Midnight' Kentucky Blue Grass: 25 percent.
      2. 'Rugby II' Kentucky Blue Grass: 25 percent.
3. ‘Ram I’ Kentucky Blue Grass: 25 percent.

B. Non-Irrigated Seed Mixture:
   1. 'Kitty Hawk' turf type tall fescue.

2.02 SOIL MATERIALS
A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.

2.03 ACCESSORIES
A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.
B. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.
C. Erosion Fabric: Jute matting, open weave.
D. Stakes: Softwood lumber, chisel pointed.
E. String: Inorganic fiber.

2.04 TESTS
A. Provide analysis of topsoil fill under provisions of Section 01 4000.
B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.
C. Submit minimum 10 oz sample of topsoil proposed. Forward sample to approved testing laboratory in sealed containers to prevent contamination.
D. Testing is not required if recent tests are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that prepared soil base is ready to receive the work of this Section.

3.02 PREPARATION
A. Place topsoil in accordance with Section 31 2200.
B. Install edging at periphery of seeded areas in straight lines to consistent depth.

3.03 FERTILIZING
A. Apply fertilizer in accordance with manufacturer's instructions.
B. Apply after smooth raking of topsoil and prior to roller compaction.
C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
D. Mix thoroughly into upper 2 inches of topsoil.
E. Lightly water to aid the dissipation of fertilizer.

3.04 SEEDING
A. Apply all seed at a rate of 3 lbs per 1000 sq ft evenly in two intersecting directions. Rake in lightly.
B. Do not seed areas in excess of that which can be mulched on same day.
C. Do not sow immediately following rain, when ground is too dry, or during windy periods.
D. Immediately following seeding, apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.
E. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.
F. Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches.

3.05 PROTECTION
A. Identify seeded areas with stakes and string around area periphery. Set string height to 12 inches. Space stakes at 48 inches.
B. Cover seeded slopes where grade is 4 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.
C. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Provide 12 inch overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.
D. Secure outside edges and overlaps at 36 inch intervals with stakes.
E. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
F. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

3.06 MAINTENANCE
A. Provide maintenance at no extra cost to Owner; Owner will pay for water.
B. See Section 01 7000 - Execution Requirements, for additional requirements relating to maintenance service.
C. Maintain seeded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.
D. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.
E. Neatly trim edges and hand clip where necessary.
F. Immediately remove clippings after mowing and trimming.
G. Water to prevent grass and soil from drying out.
H. Roll surface to remove minor depressions or irregularities.
I. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
J. Immediately reseed areas that show bare spots.
K. Protect seeded areas with warning signs during maintenance period.

END OF SECTION